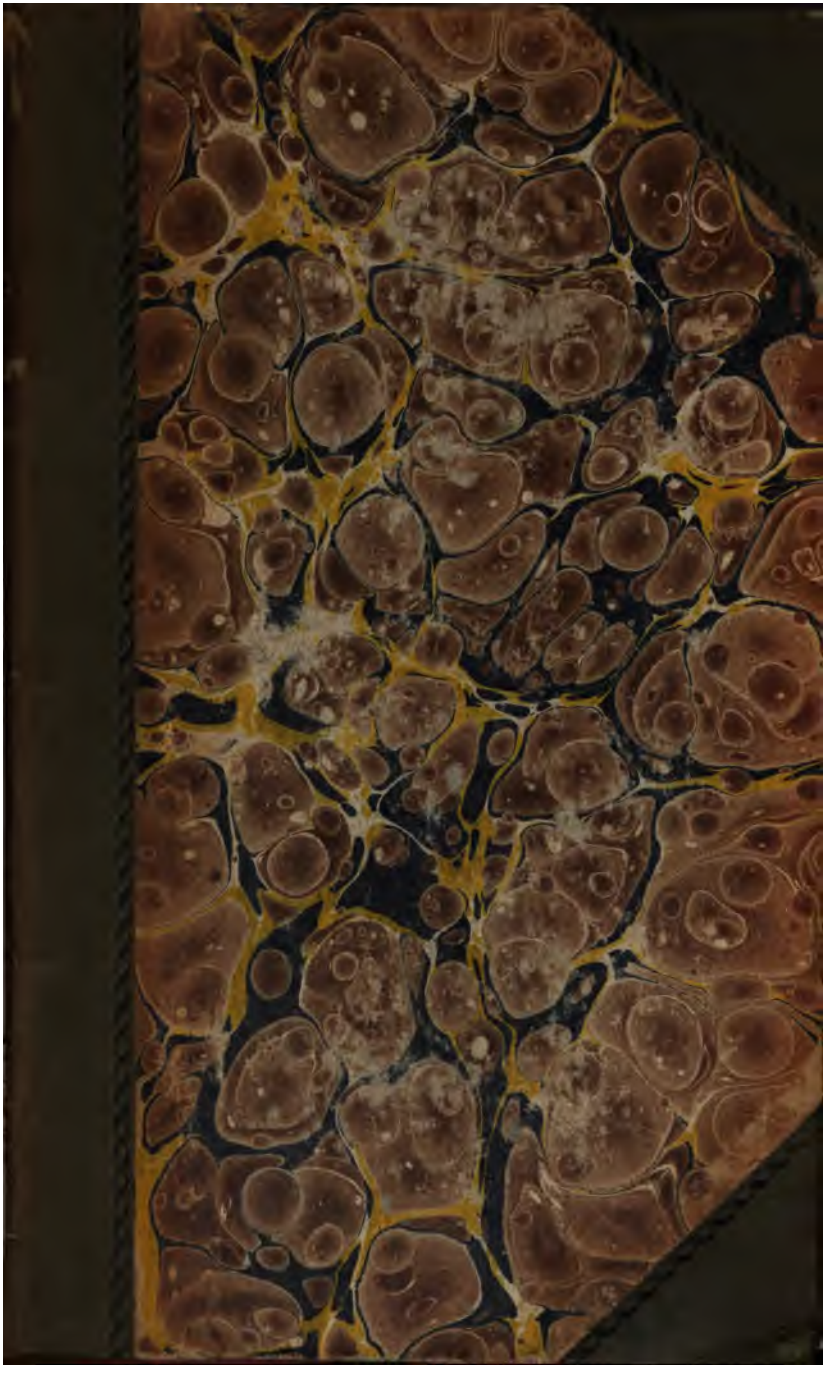

THE

PRINCIPLES OF AGRICULTURE.

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THE

PRINCIPLES OF AGRICULTURE.

BY

WILLIAM BLAND, JUNIOR.

"Bis quæ solem, bis frigora sensit." VIR.

"Science possesses the true key to man's omnipotence over matter."

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PREFACE.

HAVING given much time, and thought deeply upon the various subjects treated of by writers and the converse of practical men on agriculture, I have never been able to find that they sufficiently explain or elucidate the *causes* of the various modes practised. The effects alone are argued upon, or if the first causes are noticed, it is without any explanation as to their origin. I have therefore thought that it would lead to a practical benefit to all agriculturists, if I could show the origin and explain the cause of the first principles of agriculture upon a plain and simple basis. With this view an attempt is made to explain the *causes* of the improvement of land, proceeding either from fallowing, manuring, laying down to pasture, variation of crops, draining, and irrigation.

Each of these subjects will be respectively investigated, and it is hoped that the *causes* above alluded to will be made evident in the course of the enquiry. The food of those plants usually cultivated for man and beast will be defined, and how far man can influence the same by his industry, and the assistance he is able to derive, throughout his labours, from the effects of the seasons, if skilfully availing himself of their changes.

The book is divided into ten chapters, commencing with the analysis of vegetables, and of the sources whence they derive their support, in order to obtain a correct idea of what their food must consist. Next, on the ability of man to increase or decrease the food of plants, with a list of those facts by means of which he influences the fertility of the soil. These are regularly gone into, bringing forward so much of the practical part of agriculture as assists to illustrate and confirm the objects of research. An outline is then given of the nature and the cultivation of those plants grown for the benefit of society, with the view of laying down a succession or courses of

crops applicable to rich, moderate, and poor soils. The tenth chapter, being the concluding one, contains a few hints to young agriculturists.

I have been careful, as far as lay in my power, to remove every doubt that has presented itself to my mind on any part of the subject, by submitting the object of it to the test of experiment; and some difficulty has arisen with me on endeavouring to express my thoughts sufficiently clear to those persons who are unacquainted with the outlines of chemistry and practical agriculture. But as there are so many books extant relative to both of these, I hope any obscurities, springing from the unavoidable introduction of some of the terms, particularly of the former science, will be readily got over. Any person conversant with the practical part of husbandry, with a little knowledge of chemistry, will, I am persuaded, meet with few obstacles, if he only allow himself time for consideration.

Before laying down my pen, I cannot lose the favourable moment to express here my sincere gratitude to the late HENRY GODFRY FAUSSET, Esq., RICHARD TYLDEN, Esq., WILLIAM BLAND, Esq.,

Sir JOHN MAXWELL TYLDEN, and some other friends, for the assistance I have derived from their experience and advice throughout this work. I have also to acknowledge the obligation I am under to the author of Lectures on Agriculture (Sir HUMPHREY DAVY), for having taken the liberty to transcribe into my pages, his analysis of plants and soils.

WILLIAM BLAND, JUN.

Hartlip, near Sittingbourne, Kent.
Feb. 28, 1827.

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PRINCIPLES OF AGRICULTURE.

CHAPTER I.

On the analysis of vegetables.—The sources of the food of plants, and the analysis of these sources.—The similarity between the materials of plants and their food.—The analogy between a plant and an animal.—The food of all plants the same, but is selected in different proportions by different plants.

VEGETABLES, according to the reports of the first chemists of the present day, are found to yield, on analysis, the following substances:

Gum with its different modifications, starch, sugar, albumen, gluten, gum-elastic, extract, tanning, indigo, narcotic principle, bitter principle, wax, resin, camphor, fixed oils, volatile oils, woody fibre, acids, alkalies, earths, metallic oxides, and saline compounds.

These substances are reducible into carbon, oxygen, hydrogen, nitrogen; with a small proportion of the earths of silica, alumina, lime, magnina, potash, together with some sulphur, phosphorus, and muriatic acid.

The above, it seems, are the principles of which plants are composed; the proportions and kinds only more or less varying.

From the analysis of vegetables, we proceed to inquire what constitutes their food, and whence it is derived. To gain this information we are naturally directed to examine the places where plants grow and flourish; for they, not being locomotive, must there procure the same. The soil then, with its various combinations in which plants root, becomes one part: the air, by which the stems, heads, and leaves are surrounded, another: the rain and dews which fall to the earth, a third: and the influence of the sun, light, and darkness, the fourth.

OF THE SOIL.

Every productive soil has been found to contain lime, silica, and alumina, as the basis. The rest, composed of the materials of vegetables and animals in a more or less decomposed state: and the principles of these are oxygen, hydrogen, nitrogen, carbon, with the bases of the alkalies.

OF THE AIR.

The air is composed of oxygen, nitrogen, carbonic acid or carbon.

THE RAIN AND DEWS.

The rain and dews, or water, is formed of oxygen and hydrogen.

OF THE SUN, LIGHT, AND DARKNESS.

The sun is the grand agent of the Supreme Being to animate and to perfect all life on this earth; by exerting a powerful mechanical and chemical influence on matter, by its heat and light; which are both essentially assisted in their effects, on alternating with cold and darkness. The vegetable kingdom experiences, of course, a share of its almost divine presence.

By comparing these principles with the list of the component parts of vegetables, we find they are one and the same. In fact, if we think at all on the subject, how can the case be otherwise? since "out of nothing something cannot come": consequently, we arrive at this conclusion, that the food of plants is neither more nor less than the principles of which they themselves are composed.

Like an animal, the soil may be considered as its stomach, mechanical basis, and support; the fibres with the smaller and larger roots, as the lacteals and conductors of such food as is found there; the stem, the body; the branches, and more especially the leaves, as the lungs; and effect the same great ends.

A plant sends its roots and fibres into the soil around it to obtain the chief proportion of its food. This food is at first in a half concocted state; partly in the form of sap, partly in the form of gas: and which ascends through the stem into the branches and leaves; in which, by their immense surface the food is exhibited to the influence of the sun and light; the cold and darkness; and the air and moisture. This chyle, to carry on the simile, then undergoes those essential changes to complete its proportions, by receiving from the air, and from the water in the air, that extra quantity of oxygen, hydrogen, nitrogen and carbon, which might be more or less deficient, or less suitable in the soil; and discharging any of those gaseous materials and compounds which are unnecessary or uncongenial to the economy of the plant.

The materials thus enriched and prepared, descend to those parts of the plant where wanted; when they are again subjected to the process of those glands, which are in all probability employed

and situated in the neighbourhood of the young wood, the blossoms and future fruit. We may also suppose the petals of the blossoms, with the fruit and seed cases, act as other glands or laboratories, as they cannot be useless, to assist also in the formation and perfecting the beauty and perfume of the blossoms, as well as in the growth, the richness, and the nourishment of the seed and fruit.

By this peculiar power and all-wise contrivance in vegetables, they are enabled to combine and arrange a few simple principles into that infinite variety of form, beauty, strength, taste, perfume, and magnitude, which the vegetable world everywhere displays.

Corn being a vegetable is of course influenced by the same causes. But as the leaves of the species, wheat, barley, oats, and rye, are not so numerous, a provision has been made by Nature in the stem, which, by its thinness and hollowness affords a large surface for the juices to be exhibited to the sun, air, and rain; with the knots in the straw, acting, in one instance, mechanically, after the manner of bond timber in a building, and in another, performing the office of glands to the grain.

To assist this subject; look at a piece of land covered with wood, or a garden with flowers: what

a variety of trees and plants are seen flourishing upon each. They all have the same soil to live upon, and are all exposed to the same precise external circumstances of air, weather, and seasons: consequently all have the same materials to select from. What then occasions their great variety? Why, neither more nor less than the differenc first imposed by the Author of all things, in the constitution or organization of each species of wood and plant; which, from the midst of the same materials, select distinct proportions that produce all the variety and beauty which every wood and garden presents.

CHAPTER II.

On the ability of man to increase or diminish the food of plants.—What constitutes fertility and barrenness in soils.—A list of facts which cause fertility, and destroy the same.

With this idea of the nature of the food of plants, the next inquiry is the means by which the same can be increased or diminished by the agency of man.

To obtain these ends, we must gain the intelligence of what constitutes fertility in soils; and also what is to be understood by the loss of fertility, or the approximation to poverty and barrenness. Let them be defined thus:

First. Fertility is neither more nor less than the power existing in a soil, either naturally or artificially, or both, of yielding readily those elements of plants contained within it, to the active selecting energies of vegetation when required by a growing plant; the powers of which, being always sufficiently strong, with the aid of the sun and seasons, to

overthrow the balance of affinities of the particles of a soil that is fertile.

Second. The loss of fertility in a soil arises from a deficiency of those materials requisite for the growth of plants. If the deficiency be positive and great, and beyond the powers of vegetation to make up from the air and rain, such a soil is indeed very poor. But if the vigour of a plant suffers, not from a want of the necessary food, then the cause is owing to the balance of affinities of the materials composing the soil being too strong to yield to the chemical energies of one, or only certain species of vegetables.

Third. Barrenness is that state when the balance of affinities is strongly established between the particles of the soil, as in a stone or rock; when no decomposition of air and water, or vegetable materials, if any are present, takes place; and without the least yielding of this balance to the active chemical energies of vegetation; which, in consequence, cannot advance beyond its own inherent powers, as a seed on the highway. Hence we infer, that when a soil is exhausted by frequent cropping, and without the least addition of manure, together with bad cultivation; it is approximating to this state in the equilibrium of its various particles.

It is now necessary to return to the inquiries relative to the influence, and the means that man has over the productiveness and unproductiveness of the soil. To do this, a selection of those facts must be made, which restore and continue fertility to the soil, or vigour to plants: and those also, which destroy that fertility, or that healthy vigour so requisite for the unfolding and perfecting of plants.

The under-written is a list of those generally known and approved means which assist in the restoration and continuance of the fertility of lands, from the evident great benefit exhibited by the succeeding crops.

A well cultivated fallow;

The application of manures;

Variety of crops;

Rest, as in pastures or artificial grasses;

Draining, and irrigation.

The following are the facts which exhaust and deteriorate land: and which indeed are the reverse of the above. As

Neglect in cultivation;

No manure;

Constant cropping, particularly with the same species;

Surface-water not carried off by drains;

And complete drought.

To consider regularly the five restorative principles that are under the control of the husbandman, the fallow is the first that presents itself, and is considered in the next chapter.

CHAPTER III.

The fallow defined.—Its effects.—Similes to elucidate the subject.—The soil mechanically retains, and chemically combines with air, water, and vegetable and animal manures.—Whence the source of fertility.—Remarks on the practical parts of the fallow process.

OF THE FALLOW.

By fallowing, is meant a repeated mechanical moving and pulverizing of the soil, to a depth of eight, ten, twelve or more inches, with the plough, the harrow, and the roll; and permitting, during the process, which usually occupies the spring and summer months, no vegetables to grow.

This mechanical process usually commences at a dry time in the autumn: and the land, from the consequent unevenness by the furrowing of the plough, presents a large surface to the frosts, snows, sun, and weather of the succeeding winter. The effects, from such an exposure, shiver the most stubborn clods, and with no cost to the husbandman *.

* If it were practicable to expose land to the effects of the

In the spring, the surface is harrowed and dressed down; the weeds picked off or destroyed; and the field again submitted to the plough; when the under side is turned up to the heat and moisture of the sun and showers, and to the drying winds. This exposure should be continued, if the weather be favourable and time permit, till quite dry, then to have a shower and get dry again, with the surface in the roughest state; that the effects, from the alternating extremes of heat, moisture, and dryness (the great decomposing agents of Nature), upon the largest possible surface, may the more speedily render the clods tender, the proper opportunities being taken for the operations of the harrow and roll.

Another ploughing, and perhaps dressing, succeeds: then a fourth; and probably a fifth; when the duties and object of the husbandman are performed and accomplished.

winter season, more than is generally done, by one or two extra ploughings during that period, the advantage gained in fertility would be considerable. But, the fear of kneading the land whilst wet, and the impossibility when frosty, sets all attempts on any large scale at defiance. In a garden, a bed may be dug and re-dug during slight frosts, and thus fresh and fresh surfaces and clods turned up to the weather, when the great benefit of the winter's exposure and pulverization can be obtained; and indeed is so by industrious gardeners.

A soil that has been so treated and exposed, even if very stiff in its nature, and poor when the operations were commenced, is found greatly improved in its tenderness and in its powers of fermentation, consequently in its fertility; and the benefit arising from the fallow, is in proportion to the time and labour bestowed, and the interval before a crop is again taken.

Naturally good soils need but a short period for their restoration, because they are readily brought to a pulverized state, and of course proportionally soon improved in their powers of fermentation *.

* Fermentation is the struggling of different affinities of materials in contact with each other, to enable their respective proportions to continue at rest: or the struggling of various particles of matter for the balance of affinities. It is one of the chief objects of a well directed cultivation to continue this fermentation, having the seasons and the power of vegetation to assist, lest vegetation should be exposed to a too long continuance of the balance of affinities.

Land dries much sooner when moved, than when left untouched. Just harrowing the surface dries the soil rapidly, the weather being fine; and why is this? It is because the water and air in the unmoved soil is in a comparative state of rest or balance; and having the same surface exposed to the sun and winds for some time, they at length saturate the particles of the soil exposed to their influence, consequently at last excite little fermentation: when, however, the sur-

Whereas the stubborn and almost barren require at least a year, or indeed better if two years are devoted to a well directed cultivation, before an equal degree of pulverization and powers of fermentation can be accomplished.

From the tendency of the fallow to render light lands close, and stiff lands light, it favours the approximation of the two different soils to the same state of fertility.

Having gone through a detail of the particulars of the mechanical part of the fallow process, its effects are the next object of attention.

The balance of affinities, or the equilibrium of the particles of matter composing the soil, are very essentially disturbed by the operations of the plough and harrow; indeed so much so that scarcely two particles, it may be said, that were in contiguity before the commencement of the ploughings, are to be found together at the conclusion of the operations; also the particles of stale air and moisture that were within the interstices of the soil at first, together with those particles in slight combinations with the soil itself, have escaped, and their places are supplied with fresh; consequently every way favouring fermentation in a high degree, as well as

face and clods are disturbed by the harrow or plough, every part is fresh to both sun and air, fermentation becomes strong (proved by a thermometer) and dryness rapidly ensues.

being rendered more easily permeable in all directions for the infant roots of future plants *.

Now a soil, before it is broken up by the plough, is—as to its interior particles, and the air and water that may occupy the few cavities—in a comparatively quiescent state, because the various particles have entered into a chemical union with each other. That is to say, the materials of the soil are saturated with those substances they could then combine with; and therefore would so continue to remain, if the subsequent variety of the seasons did not tend in some measure to destroy the equilibrium.

A few examples may contribute to the better explanation of the above, and also materially assist future investigation. They are the following:

What is the use of stirring or shaking two liquids when put together, or one or more liquids with one or more dissoluble solids? The object is, to facilitate a chemical union with each other of their respective atoms, which the occasional stirring effects, by removing one portion after the other of the atoms of one liquid, when they have been sufficiently long in contact to perfect a union with a portion of the

* A gardener, whilst digging, always takes care to break each spit in pieces, both on the top and in the trench. He does this, knowing from experience that this extra labour will be amply compensated for, by the proportioned superior produce of the next crop.

atoms of the other liquid or dissoluble solid, till all the combinations of which the nature of the materials are capable of entering into, under their present circumstances, have been completed.

Let a sponge, or a piece of cloth, be thrown into any dying liquid that will combine with the materials of the sponge or cloth, and there permitted to remain awhile. The first effect will be, that every pore of the sponge, &c. will be filled with the liquid, and a combination with the dye, immediately in contact with the sponge, take place, when all will be again quiet. If the dye is too diluted to give the requisite colour at first, the sponge if left undisturbed, and the liquid also; for a considerable time, the shade will not be improved because a saturization has already been effected with the sponge and the dye in its immediate contact; but if the sponge, after having remained a certain time, be taken and squeezed, then returned again into the liquid, it will absorb a fresh quantity of the dye by fresh particles being exposed to its surfaces, when a second coat will be formed; and so on with a third and a fourth, at every alternate immersion and squeezing, till the requisite shade be accomplished. In this manner any degree of shade of a dye may be communicated to a piece of cloth, or other material capable of taking it up, in a much shorter time than in any other way.

Again, how does Nature effect the oxidation of the blood in the lungs of animals? It is upon the same simple principle: for what does she do to gain this important end? Let us for a moment observe ourselves in this instance; we inhale a quantity of air into our lungs, and then immediately after exhale another quantity; a moment's pause ensues, when the process is repeated again and again, to the end of our existence. Now the lungs are a body somewhat like a sponge, but composed of an infinite number of ramified tubes, by which means an immense surface is exposed to the air.

The air that is inhaled is the atmospheric, which is composed chiefly of nitrogen and oxygen. The air exhaled is different, being partly nitrogen, partly carbonic acid gas, with water in a gaseous form. We see then that the carbonic acid gas has been substituted for the oxygen, and if respiration be suspended, the air, just fresh received into the lungs, cannot yield up more than its quantity of oxygen, if continued within them for the space of an hour; and thus a balance, or equilibrium would be established; consequently, to gain more of the oxygen, the stale air must be expelled to admit its place being occupied by a fresh quantity of atmospheric air. This is effectually done by the moment's pause after exhalation, as the pause admits of the expired air escaping and ascending out of the way,

having been rarified by heat, and rendered lighter than the atmosphere, and thus making a pure entrance for the inhaled air.

Another simile, and a familiar one, may also be brought forward. It is of a fire that wants stirring, which exactly resembles a piece of land permitted to remain awhile unmoved. For the fire is becoming stale, or a balance of affinities is forming, or, properly speaking, the surfaces of the fuel, immediately in contact with the air, formed a combination with the air whilst the heat was sufficiently strong to effect it; but by the hollowness consequent on combustion, from the consumption of a portion of the fuel, the particles in a state of ignition become more and more distant, when the heat proportionally declines, till falling below the power of decomposing the air, which now only gets rarified in its passage through the embers, and thus robs them of their remaining heat, when the fire soon goes out. If, however, it be stirred in due time, and with judgement, whilst the heat is sufficiently powerful to decompose the air, a large exposure of fresh, or unsaturized surfaces and particles, are presented to the current of fresh air, together with the approximation of the parts in combustion, which, by consolidating the heat that was before distantly divided, materially prevents the further loss of the same, and consequently favours imme-

diate ignition. The fuel being put closer together, is however left sufficiently porous for the free circulation of the air, which accordingly enters into chemical union with those particles that are capable of receiving it; when the oxygen of the air, from a gaseous form, assumes a more condensed one with the fuel, the latent heat is in consequence given out, and shows itself in the general redness; should hydrogen be present, as in coal or wood, it unites with this gas and becomes cheeringly visible in the flame.

To further elucidate this meaning respecting the balance of affinities, and the advantage gained by moving the soil, the reader is requested to inspect a dung-mix-hill that has been made two or three months. This mix-hill will be found, if trodden down hard by the horses and carts during the time of making, or the interior defended from the outward air by a covering of earth, in a comparative quiescent state; and why? Because the fermentation has gone as far as the fresh air contained within lasted, when the balance of affinities takes place. Now let this heap of manure be turned regularly over, and each spit broken and shaken in pieces, after the manner of making a cucumber bed, and spread about to prevent the same two pieces that were together before, from coming in contact again; the uncombined stale and gaseous mois-

ture will then be facilitated in their escape; and from having less affinity for the materials of the manure than the fresh air and gaseous moisture to which the materials are now exposed, will readily give place to them, when a fresh and strong fermentation ensues; and this arrives at a great height after some hours, or a few days, and so continues, till the fresh store of air and moisture, and the new position of the particles of the manure, are exhausted and saturated, when all is quiet again.

When a soil is broken up by the plough and highly pulverized, this essential effect, fermentation, is gained, which cannot take place without the presence and consequent decomposition of air or water, or both. This being the case, these two questions necessarily arise. The first; is air always present in the soil? The answer is, that it is; because it is impossible that a pulverized and porous body, such as the soil, which is always exposed, can maintain a vacuum in its innumerable cavities. The next respects the presence more or less of water in the soil. The same answer is again given, that it is present. The rains are the occasional contributors, together with the dews; and the constant interchange of the air, charged with moisture, ascending and descending through the upper part at least of the pulverized soil, by the influence of the interior fermentation, the day's

heat, and the night's chill, leave behind in this climate, a quantity sufficiently great to keep the soil moist even in the driest seasons.

Of the two former there is a positive certainty: and of the latter, the ploughman's experience equally satisfies him of this fact; but it is not discoverable in unmoved land, which is in consequence generally hard, dry, and cracky, during the summer months.

The next step to be taken in this inquiry is, to ascertain whether the soil, by cultivation, will mechanically retain, and chemically, or by cohesive attraction, as Sir H. Davy says, combine with air and water, and any gaseous materials.

What has been shown already relative to the porous nature of the cultivated soil, equally answers in this case. For having proved that air is more or less present and diffused through the soil in proportion to its improved state; then this presence of the air denotes also its mechanical retainment.

The next investigation relates to the capability of the various soils chemically combining with air and its component parts, and the products of decomposed vegetables and animal manures, beginning with the latter.

When vegetable and animal manures are applied to the soil and buried by the plough, they undergo fermentation, and gasses of various natures are

evolved; these, passing into the finely pulverized earth, become arrested in their nascent state by the numerous particles of the same, and are so strongly retained, as to exhibit their presence for a series of years afterwards (although every part of the manure appears gone), by the superior crops that follow, and which gradually consume them. If these gasses were incapable of chemical union, then from their specific gravity being so far inferior to that of the soil, they must effect their escape in a greater or less degree, but more particularly so at every successive ploughing; consequently with the proportioned impoverishment of the land according to the frequency of the operation. However a long age of experience has no proof of such result; therefore the detainment of the several gasses for such a period must be more than mechanical, consequently then, is chemical *. The like reasoning applies to atmospheric air.

* This is a strong practical fact; that the particles of the soil have a superior affinity for the component materials of animal and vegetable substances than the atmosphere; if true, the soil never can be so injured by exposure as some persons have imagined: indeed facts are every way in favour of exposure, so much so that it is absolutely necessary from the essential benefit the land derives by being allowed to breathe, to exchange its stale bad materials for those that are fresh and good.

Meat, as of a dead sheep or horse, is sweetened and made

The presence, or mechanical suspension of water in soils, has been before shown; and its chemical or cohesive combination with the particles of the earth, is on the same principle as water with lime; though the union is not so strong; but the strength of the union, and the affinity of the soil for water, are increased by cultivation*.

tender by being buried in the ground for a day or so; for the soil commences a digestive process, and imbibes and retains all the putrid effluvia as it generates. Dogs are, by their instinct, aware of this when they bury a bone, otherwise, from the acute smell of their own species in general, their store would be easily discovered, if the least effluvia escaped during that time, and the treasure robbed; but the occurrence is very rare.

* A portion of soil being taken from a cultivated fallow, and compared with an equal quantity from an exhausted soil close by, and with corn in ear growing upon it, the differences were; that the fallow soil retained moisture longer than the exhausted soil, and when both were equally dried, the former regained moisture from the air quicker than the latter—a most important fact. Again, a thermometer was inserted three inches into a soil cultivated a few hours before, and then put the same depth into the same soil close by, which had not been so recently moved; the result proved that the fresh moved soil raised the quicksilver at least two degrees higher than the unmoved, and selecting a spot just manured and fresh moved, the difference of temperature was found greater.

Cultivation increases the powers of decomposition and

When there is an excess of water after saturisation, it evaporates in dry weather, and forms a mud, when very wet.

Before terminating this part of the inquiry, the following well known fact is adduced in support of the argument; that aration alone is capable of fertilizing land. Whence is the source of such fertility? We know of none; if we exclude the air and water, and the improved digestive powers of the soil, saving the pulverization; which, indeed, without these would be next to nothing; therefore these

composition of the soil, or fermentation, denoted by the proportioned increase of the growth of plants; likewise by the more rapid decay of any vegetable or animal substances contained therein. But vegetables growing in a soil have the tendency to lower the temperature of the same, caused, it is conceived, partly by their shade, and partly by their very act of growing, which by transforming the more solid and liquid manures about their roots into a rarer or gaseous form, occasions the difference, from the consequent consumption of a portion of the surrounding heat taken up in a latent form during the rarefaction of any of the above substances.

It is also known, that fish-manure ploughed in early for a fallow lasts longer than when ploughed in for a crop on an unfallowed season. Thus proving again that cultivation promotes the chemical powers of the soil. On the same principle farm-yard manure will go further when put on a

three must be pronounced as the real source, which, under the influence of the sun and seasons, yield to the hand of industry their hidden treasures, and fixes them in the soil, to be gradually taken up by the future vegetation.

This satisfactory conclusion may at length be drawn, that the particles composing a well-managed soil are capable of mechanically retaining and chemically combining with air and water, and their principles; and also with the various products from vegetable and animal manures. And this capability of the soil is to be improved, strengthened, and perpetuated, by well-directed cultivation; thus proving not only the use, but the necessity and importance of cultivation.

To dismiss this interesting chapter without a few remarks on the practical parts of the fallow process would be incorrect, and to do so it is necessary to review some of the operations, and make comments as we proceed.

The commencing the operations for the fallow in the dry part of the autumn is highly necessary, and the advantages are these: that the plough presents an entire fresh and somewhat dry surface to the influence of the succeeding winter, instead of the same which had been before long exposed during the preceding summer, and was in consequence become stale, therefore the soil would not derive the pro-

portion of benefit it ought to do from the ensuing winter's frosts, rains, and other changes, which however will be gained by the particles of the now fresh turned up surface. Again, the land being broken up as dry as it will plough, and never mind how rough, the surface not only presents a greater number of particles to immediate exposure, but being at the same time rather dry than otherwise, the winter's fresh rain and snow enter more readily, and generally into every part of the clods, and after the manner of lime, crumbles the same to powder. Whereas, if the same land be ploughed up wet so as to knead by the horses, the cavities of the soil, from this cause, being already filled with water, like the sponge, can receive no more, and therefore from the approaching winter there is no chance to be again moved or become dry. The fresh rains and snows which may fall cannot penetrate through the clods, every interstice being already pre-occupied by the former moisture; and this same quantity thus locked up, as the liquid dye in the sponge or cloth, and the air in the lungs, when it has parted to the soil all that it is capable, the balance of affinities is established by the saturation; and no further benefit is to be expected, except upon the mere surface, where the frosts and sun may occasion a dryness. Such land, when ploughed in the spring, will, as the expression is, cut up whole furrow, instead of being in the fine

and tender state of the land that was ploughed dry, and now again ploughed in a dry time also*.

With respect to the burying all the stubble and weeds; these should always be done when practicable, and if done, they will, during the exposure of the winter season, particularly in very wet and stiff land, keep the same open and porous, and thus, not only make it more easily divisible by being blended with the soil, but assist the running off of any superfluous water by the hollowness which the stubble naturally occasions, at the same time admitting a circulation of the air; besides, whatever of the stubble and weeds goes to decay, fertilizes, lightens, and improves, at no expense.

If a person follows the plough in the spring whilst stirring that land which was ploughed in the autumn, where the stubble and weeds were buried, he will see that the land, in turning over, separates readily into pieces where the stubble is intermixed, and thus materially assists in the commencement of its pulverization. This stubble, on examination, will be found in a blackened and mouldy state, like

* The best remedy, when the season and time obliges the land to be ploughed wet, is, to plough the furrows up an edge as much as possible, that the water may drain away the easier, with a greater surface being thus left for the frosts, sun, air, &c. to operate upon. Land should never be ploughed flat when in a wet and kneady state.

manure, with the green weeds quite decayed, excepting the hearts of some of those plants that are of the biennial and perennial kinds; all this proceeding from the fermentation which ensued during the changes of winter, aided by the easy decomposible nature of the substances buried, and taking place too at a period when vegetation is at the weakest; in consequence, the decay of the weeds, rather than their vegetation, followed, to the greater benefit of the land. Whereas, if the weeds had been suffered to remain unmolested all the while, they would, at least, continued alive, and if a mild winter, have grown.

The advocates for not ploughing in the autumn say, in their defence, that such lands plough up more tender and dry in the spring. Let this be granted, because they may argue, that the under soil, not having been disturbed by the plough, becomes porous as the roots of the former plants decay, as well as retaining uninterrupted the old water-courses and cracks, which were formed the preceding summer, and thus let off the winter's rains and snows; also, the old beaten down surface arrests a part of the water which is then dissipated by the sun and winds that follow. In answer it must be observed, the object of the husbandman is not only dryness, but an improved fertility by the winter's exposure, and which cannot take place in an unmoved soil,

according to what has been already stated, and likewise, because the channels and cracks, similar to a fire, become hollow, and want stirring; having had the particles of the earth lining their surfaces so long exposed to the summer's rain and air, they thus become effectually saturated as far as they were capable of receiving, and in consequence, little or no after benefit can be gained from the succeeding winter's rain and snow. Such reasoning as the non-autumnal ploughers use, only applies, if with any force, against those farmers who are in the habit of ploughing up their land at that season of the year when really too wet*.

The spring tillage for the fallow comes next; but before entering upon particulars it may be asked,

* Land improves very slowly indeed when suffered to lie unmoved; if otherwise, the not cultivating of it would of course be the cheapest plan: but facts are the reverse, and the cause easily explained. Although the unmoved land receives the effects of the same sun, the same rain and winds, yet little fertility is left behind, because the surface particles are early saturated, when whatever comes afterwards is lost to them. No extra heat and chemical powers are communicated to the soil by cultivation, no change of position of the particles of the soil relative to each other takes place, and from being deficient of these essentials, no extra fermentation can ensue, consequently, its improvement in fertility must be proportionally small; and this is borne out by facts. Therefore, every omittance of cultivation, if a gain in labour, is a loss in fertility.

which of the four seasons are those best calculated to crown our operations with the greatest success? The spring and early part of the summer are decidedly to be preferred, the land having of course been previously rough ploughed up in the autumn. This opinion is thus defended.

In the first place, let this question be put, when is vegetation the strongest? Why, certainly during the spring and early summer months; then of course must be the time of the greatest chemical changes with the soil, air, and water: therefore, the more the land is exposed to the influence of the sun, air, and rain, by cultivation at this important time, the greater will be the increase of fertilization.

To account for all this is the next question, and it is thus attempted. That contrasts and extremes, acting alternately on matter, produce in general the greatest effects, by weakening and destroying the balance of their affinities; as is instanced in the familiar case of hot water breaking a glass that is cold, and cold water breaking a glass that is hot. But the continuance of such contrasts for any length of time in either extreme, preserves the equilibrium of their particles unaltered*; as for example, paper when dry, and the piles of bridges that are always

* The preservation of fish and meat preserved in ice is the result of the strong balance of affinities.

Meat preserved in salt, fruit preserved in close stopped jars and bottles, are instances of the same kind.

wet. What have we then so favourable to the overthrow of the chemical affinities of the soil? A winter, the very extreme in its nature to the preceding summer, as being a period overcharged with moisture and cold, in opposition to its dryness and heat. As these extremes of wet and cold continue for about six months, the very active energies of vegetation, and of composition and decomposition, are not to be wondered at, when the opposites, heat and dryness*, are increasing in their powers in the spring and early summer months, till the sun has reached its greatest height and limit. The rays of the sun afterwards, being on the decline, become daily less and less powerful, therefore less and less effect must be produced, and this explains the cause why the vigour of vegetation is then seen to cease†, and with it we naturally infer, the fertilizing effects, as respects composition and decomposition on the soil also, with a consequent tendency at the same time to a rest in their several affinities; though afterwards the autumn rains come, and vegetation is

* That is to say, though more rain is said to fall in summer than in winter, yet it quickly vanishes again, and by its evaporation assists, no doubt, in the decomposition.

† Upon the same principles may be explained the cause why the morning sun has more effect upon vegetation than the afternoon.

seen to revive a little, yet winter soon follows, and seals up all with its frosts.

OF THE SPRING TILLAGE.

Should the land be extremely foul, harrowings and scarifyings*, with pickings and burnings, must be had recourse to whilst the land is in the driest state, and all completed, if possible, before the next ploughing. The plough may then be introduced and let into the land the greatest depth required,

* Scarifying is very well for cleaning land, but never will answer as a substitute for the plough; because, a scarifier is unable to bring up and turn over the fresh soil of the bottom to the top for exposure, like the plough; consequently, the top surface soon getting saturated, gains no more benefit from the sun, air, and rain, however often the same surface may be moved.

On following the plough, whilst preparing a bean land for wheat, much of the stubble of the barley crop ploughed in for beans was observed undecayed, although the last crop, beans, being a drilled one, was horse-hoed at least three times. Proving, that the effects of superficial cultivation do not descend with much influence below the actual operation; also proving, that the lower materials of the soil must be actually moved, and brought up to the sun, air, &c. before the requisite strong fermentation and benefit can ensue.

that the largest possible mass of soil may gain the benefit of the future exposure and tillage. With a field fairly clean the ploughing may at once commence, as the surface will be quite tender, and sufficiently pulverized without the aid of the harrows.

If the fallow is to be manured, no better time can be chosen than the present to be now ploughed in—but more of this hereafter.

During the early spring tillage, be careful to knead the land as little as can be avoided, and, as the season advances, it is best not to suffer a horse's foot or a cart-wheel on the surface until the soil beneath is too dry to knead*; because all the former labour will be in a great measure lost, whilst the

* A clayey soil when rammed quite close for the bottom of a pond, will remain in a perfect state of the balance of affinities for more than a century; for if it did not, it would soon lose its property of holding water. Now land of a clayey nature in a field will be affected similar to the clay at the bottom of a pond, if trampled on by horses in a kneady state; and the evil will be proportional to the purity of the clay. If it is full of manure and foreign substances, the kneading will go off in time, by their fermentation. Pond makers are aware of this fact, and therefore carefully eject all vegetable and decomposible substances from their clay before ramming it down, knowing that they will be the means of destroying all their present labours, by breaking down the texture of the clay, and thus cause the pond to leak after a few months or years.

time is too short to do it over again. Nevertheless, should necessity oblige a husbandman to plough his land before it is fit, as he is to expect the extremes of dry weather instead of the winter's rain, the clods may get perfectly dry, and the spring showers falling afterwards would repulverize them. The main object is to let the clods be quite dry, when, if rain does not fall, they, being returned to the bottom of the furrow by the next ploughing, will gain sufficient moisture to dissolve and pulverize them. In fact, the plan of always ploughing in, when possible, a dry, dusty surface, instead of a wet one, is to be preferred, because the extremes of dryness of the former surface being turned to the bottom of the furrow, where there is always moisture, which being absorbed in an equal degree by the dry soil occasions a rise of temperature readily detected by a thermometer, consequent on the union with the moist earth and with the air contained within the interstices of the clods. But when the top surface is ploughed in wet little or no interchange can take place, for the reasons before adduced.

After the land has been ploughed a second time, the question arises, whether the surface should be left in a rough furrow state or harrowed fine down? To this the reply is by no means difficult, since the rougher it is left, the greater is the surface exposed to the sun, rain, and wind, and, as the object is to

have the surface as dry as possible before being again ploughed, the roughest state is then to be unquestionably preferred.

When the land is once dry, to have it any longer exposed, unless waiting for a shower, is useless, since the clods and crumbs can be no more than dry if they remain exposed for weeks in an arid season, for their affinities are at rest, as in paper or dry wood, decay or decomposition is prevented, and therefore no after enrichment is to be expected. If a good shower should come, it will prove of great value by falling on a dry surface, by causing a circulation, first, of fresh water through the clods, and then succeeded by fresh air, as the former desiccates beyond what is chemically and mechanically retained by the soil; but when again dry, no time should be lost in turning this surface under with the plough, and bringing up a fresh one to be similarly exposed; because more advantage will be gained now, by exhibiting a fresh surface to the sun, &c., than permitting it to remain unmoved.

It is quite necessary for land to lie undisturbed, after ploughing, for a certain time, before another takes place; as is the case when making bread, hay, beer, and wine*, otherwise a fallow might be

* Likewise with a fire, which requires, when endeavouring to get it up strong, to remain a time after every stirring, to allow of the requisite changes and combinations taking effect.

completed in a day, which is impossible. Now the usual period that intervenes between fallow ploughings during the spring and summer months, is from two to five weeks, which experience and the economy of a farm have decided to be sufficient and practicable; the appropriate rollings, &c. being of course applied when necessary, particularly if recently manured*, as the superficial dressings will assist in the general fermentation, therefore, in the decomposition and combination of the vegetable materials with the particles of the soil.

Before the third ploughing is entered upon a heavy roll or a light one, according to circumstances, should be passed over the field across the furrows, and this implement alone will effect, generally speaking, all the requisite pulverization at the least expense of culture and treading. This act of pulverizing displaces the previous position of the particles

* Land should remain the longest after that ploughing which turned in the manure of a vegetable nature, but then should be well dressed with the scarifier, harrows, and roll, and the dressings repeated, then ploughed up again to air the soil, for the foul matter to escape, and to imbibe fresh. This exposure might continue for a week or two, of course depending on the weather, then the manure ploughed under again, to remain some time, and to receive the proper dressings. If any seed or corn is to be sown, let it be generally on that ploughing which turns the manure in well beneath.

of the soil, and brings others into contact, thus highly favouring fermentation. If the roll be unable to accomplish the present intention, the harrows or the scarifier, or both, may of course be employed.

Suppose the third ploughing to be completed, the soil will now present to the eye and touch, a great improvement in its colour, its state of pulverization, and in its inexhaustible moisture beneath. If turnips are to succeed the fallow, and the fourth or the fifth ploughing is to be the last, then, before this takes place, the surface of the field should be reduced to the finest tilth by the harrows and roll, when the land and weather are favourable, that the seed, when sown on the subsequent plough furrow, may be deposited in and surrounded by an entire mass of close yet permeable soil, from being finely pulverized, of from six to ten or more inches in depth. This is the very object of the husbandman, because, a body of earth in the above condition is the one, experience has ever found, most congenial to the infant germination and future growth of the turnip, and which, according to seasons, will attain in consequence the limit of its developement and produce.

The benefit of the fallow process may be summed up in these words; that it replenishes the soil with fresh air and fresh water, improves its powers of composition and decomposition, strengthens its affi-

nities for the products of vegetable and animal substances, renders it easily permeable to the roots of plants, and restores, by the general pulverization, its valuable property, inherent in rich soils, the absorbing and retaining of moisture and air from the atmosphere.

CHAPTER IV.

On manures.—Specimens of rich soils analyzed.—How a standard of fertile proportions is to be obtained.—The permanent fertility of soils is by no means dependent alone on the vegetable or animal matter they contain.—A second confirmation of fresh air and fresh water constituting a principal part of the food of plants.—Strong analogy between the soil and the stomach of animals.—The sources of the food of plants available by man.—Manures, their several kinds.—Manure should be applied to land in good heart.—Three descriptions of fertility.

OF THE SECOND KNOWN FERTILIZER OF THE SOIL, MANURE.

THE manures employed to fertilize land are divisible into two kinds. The first are the mineral, the second are the vegetable and animal.

To place the argument, relative to this important part of agriculture, on a solid foundation, a few specimens of those soils that have been always esteemed by persons in their neighbourhood the best and most fertile, are laid before the reader, and comments afterwards made upon them.

First. Out of nineteen parts of an excellent wheat soil:

14 parts of silica, or large, small, and fine sand.
2 ——— lime, or carbonate of lime.
2 ——— alumina, or clay.
1 ——— vegetable and animal matter.

Second. Out of twenty-five parts of a turnip soil:

20 parts of silica.
2 ——— lime.
1 ——— clay.
2 ——— vegetable and animal matter.

Third. Out of ten parts of a fertile soil from Scotland:

3 parts of silica.
1 ——— lime.
5 ——— clay.
1 ——— vegetable and animal matter.

Fourth. Out of eight parts of a soil proper for wheat:

2 parts of silica.
3 ——— lime.
3 ——— clay.

These four specimens are sufficient to answer the purpose intended; for although there is no doubt as to the correctness of their analyses, since they have passed through the hands of Sir H. Davy, yet they will by no means serve to constitute a general scale of productive proportions; because a

variety in the sub-soils, as well as a difference in the situation and climate, must ever defy the establishment of one only. However, the above will answer every reasonable purpose; but first, an opinion should be given as to a standard of fertile proportions which can be safely relied upon, and capable of practical adoption. It is this: to select the proportions from the best soils in the very neighbourhood of the field to be improved, where the sub-soil and situation are similarly circumstanced, and the climate the same.

On viewing the proportions of silica, lime, clay, and vegetable and animal matter in the specimens selected, we are not a little surprised at the smallness of the quantity of the vegetable proportion, which on average is only as 1 to 15½: therefore, one directly decides that the permanent fertility of soils is by no means dependent alone on the vegetable share of matter they contain. This, however, must be proved; and to do so it will be necessary to estimate the produce of fertile lands, say, for the space of four years; and it will soon be found that the vegetable proportion alone is far too small in quantity to insure such abundant crops as the following:

First year. Turnips that will fat ten sheep an acre.

Second year. Barley seven quarters; or, oats eight to ten quarters to the acre.

Third year. Beans four to six quarters to the acre; or, two good mowings of clover.

Fourth year. Wheat four to five quarters to the acre.

All this from one coat of manure of the vegetable kind, and applied at the fallow.

Now the usual coat of vegetable manure on the best regulated farms, never exceeds in general, and indeed seldom equals, all the straw even they produce; because, when an agriculturist can manure a quarter of his lands each year, that is to say, return all the straw grown on each field every four years, it is as much as he is able to accomplish: and which quantity is found, from experience, amply sufficient, when conjoined with the fallow, to raise healthy and productive crops. This being the case and the fact, the more weighty and valuable part, the corn, is sold off from the lands as food for man and beast, except what may be consumed at home, which does not more than compensate for the loss of straw by thatching, by tithe taken in kind, and by waste, which will ever unavoidably occur on every farm under even the best management.

Whence, then, does the growing corn acquire the extra and necessary supply; since, as above

shown, it cannot be from the vegetable manure carted on, because that would be obtaining a greater quantity from a less, which is absurd? Is it from the materials of the soil?* Yet, how can

* Pure silica, lime, and clay, are in themselves barren; or in a state of perfect rest or balance of affinities. But when they are broken into powder, put together, and well mixed with a portion of water, their respective affinities immediately become active; fermentation ensues; is capable of increase and continuance by cultivation, especially when joined with the addition and mixture of dead animal and vegetable substances, which is still facilitated and advanced, like every other chemical process, by heat.

The individual materials, silica, lime, and clay, are not decomposed, the heat to which they are subject being insufficient: but they, by their contiguity, exert their chemical influences on each other to a certain degree, which every day's experience proves sufficient to act with the necessary chemical effect on the more easily decomposible substances of dead animals and vegetables, on air and water, as well as stimulating the energies of the roots of plants.

Fluoric acid is not found in cultivated soils: and the silex, which is detected in the straw of wheat, oats, and barley, is obtained in the easiest way by nature, that is to say, from the straw of those plants put on as manure.

EXAMPLES RELATIVE TO SILICA, ETC.

Now a piece of sugar is by itself in a quiescent state; and so is a cup of water or tea; but when the former is put into either of the latter, its solution instantly follows.

Muriatic acid and marble; sulphuric acid and spirits of

that be? for if we were to allow it to be the case, the fertile soil must, in the course of a few centuries, be reduced in quantity, and thus deprive future generations of the means of support, which is equally absurd; being contrary not only to present facts, but to the usual providence of the Supreme Being. And as regards present facts; the best soils in former times, are now, under proper management, equally as productive, if not more so, than then. The necessary supply of food must, however, come from somewhere: consequently we must look and examine around for the source or sources; and if we do look, it must be for that which is known to be necessary to plants, is within their reach, and of a nature inexhaustible.

turpentine; these, if kept separate, would continue at perfect rest for ever: but when brought respectively together, a mutual incorporation takes place, with a complete explosion of the two latter.

Take a flint and steel, and put them into a quantity of gunpowder, the balance of their affinities will still remain undisturbed; let but one spark only be elicited from the two hard substances, and every person instantly anticipates the result.

More instances might be adduced; the above are however sufficient to prove, that, notwithstanding the apparent quietude of each pure and simple compound substance, when saturated and separated, yet, how speedily their affinities are awakened into life by being brought in contact with each other, having heat, and air, and moisture as auxiliaries.

They are, then, as has been before shewn, and here again confirmed, the rain, the dews, and the air, all of which falling upon, and entering into a pulverized and fermenting soil during the process of the fallow, and thus expelling, as has been also before stated, the stale air and stale water which has been breathed by preceding plants; as gathered flowers in a glass of water on a mantel require the water to be changed every day or two, or they would droop, so a store of fresh air and fresh water, with renewed powers of fermentation, is acquired by the soil. This, likewise, takes place with fertile soils, and those in good heart, at the time a crop is growing. The fresh water, in proportion as it is absorbed by the plants, gives place immediately to fresh air, or a vacuum must ensue; therefore, these two great advantages arise whenever a shower falls, or the night's dew enters the fertile earth; and thus the rapid growth and improvement of vegetation in the growing period of the year, after every kindly shower, is accounted for. These, conjoined with the influence of the sun, the seasons, and the innate powers of growing vegetables, aided no doubt in some degree by the principles of electricity, effect the formation of corn and fruit.

Relative to the expulsion of the stale air, &c., which is so important, it is in proportion to the quantity and the general diffusion of the rain throughout

the soil, and this is of course in proportion to the state of pulverization, or adhesiveness of the particles of the soil, and its nearness to the last ploughing. The strong analogy between the soil and the stomach of animals may not improperly be adduced as an illustration of the above argument. The soil does not of itself afford the means of support to the plant, but receives the food from the vegetable manure carted on, and from the rain, dews, and air; so the stomach, by the animal's industry in gathering or catching its food, merely prepares it by a decomposing process, which so far weakens the several affinities of the matter contained, as to be capable of being afterwards selected and taken up by the appropriate organization of the plant and the animal: and this is effected in proportion to the proper constitution and health of the soil, and the animal.

This constitution of the soil*, then, is of the first importance, for upon it depends the power of decomposing vegetable materials within itself, and of

* One mark of the proper constitution of a soil is, when it neither holds moisture for too long nor too short a time, and is not easily dissolved by a shower falling upon it, so as to form a crust upon the surface impenetrable to air.

This constitution of the soil is, as has been before observed, improved, strengthened, and rendered healthy by cultivation, and by cultivation only; since manure fails of ef-

abstracting from the elements that come within its sphere the other requisites for the support of plants, all of which the soil retains with that gentle degree of combination which the selecting energies of vegetation are able to overcome.

Two sources, then, of food for plants are available by man*; the one, manure, carted upon the soil; the other, the surrounding elements. Both these are had recourse to by the practical husbandman, sometimes alone, as in carting on the manure, or making a fallow; and sometimes conjoined, as when manuring the fallow.

Of the subject of this chapter—the manures.

Of the mineral kinds, are lime†, sand, burnt earth‡, clay, marl, hedge mould, or any other of

fecting that which cultivation never does. Indeed, manure placed upon a field whose cultivation has been neglected, and chemical powers consequently weak, precisely resembles a full meal that is taken into a debilitated stomach, when disease and languor follow, rather than health and strength.

* In fact, there are but these two sources, and which two possess the true and only food of plants; the rest of the fertility depending on the proper constitution of the soil, and requisite cultivation, to keep the same in health.

† Chalk, the carbonate of lime, is known to be a great improver of the constitutions of stiff clays, and hot gravels, being put on such lands in the proportion of from twenty to twenty-five cubic yards, or common cart-loads to an acre.

‡ The compost of burnt earth and turf, is found to ensure

the earthy or mineral substances, which upon inspection are all easily resolvable into the three principal ingredients of soils, namely, lime, sand, and clay.

As respects the use of these mineral and earthy materials to improve soils, they can only act, in the first place, to strengthen the constitution and permanent digestive powers of the soil, by increasing the deficient proportions of either lime, sand, or clay, and in this way add to the permanent fertility. If there be no deficiency, they then can only prove of use to hasten the decay of vegetable matter, which is preserved in a strong balance of affinity by acids, and which lime has the power of neutralizing; or from the freshness occasioned to the soil by the application of those substances that have not been under the influence of growing vegetables before, at least not of corn. This fertilizing effect is however but transient, and the application of the materials often times expensive. In fact, this practice is precisely similar, only less effectual, to the benefit gardeners experience with their plants, when repotting them into fresh mould; and the agriculturist's cheapest and only practicable substitute,

a crop of turnips on most soils, therefore is valuable. And, there can be no question, would prove more useful than lime, were no strong acid exists.

where the soil is properly constituted, is in one or two years well cultivated and vegetable-manured fallow

Animal and vegetable manures next claim attention. These are, dead animal matter from the inhabitants of the land and sea, including bones, &c.; and the vegetable materials, of every denomination, found growing on the earth, some of which are ploughed in green*, others are partly decomposed before they are applied. But the description most generally employed, is the straw of all corn and grass, trampled down in the farm-yard by stock, and impregnated, more or less, with their excrement, which improves the strength of this kind of manure in proportion to the nature and quantity of the food given.

Soot is a manure partaking of both the animal and vegetable; being composed of ammoniacal salts, and empyreumatic oil; with a great basis of charcoal, which are readily decomposed by the action of oxygen and water. This manure is ge-

* The ploughing in of green crops, as tares, buck-wheat, or rape upon poor and distant fields, is an admirable practice; and is founded on taking the advantage, through the aid of cultivation, of those vegetables of strong and hardy natures, and obliging them to contribute the store they had collected from the elements around them, to the support, by their decay, of plants of a more useful and tender species.

nerally applied as a top dressing, but the animal and vegetable manures are always ploughed well into the soil of all arable lands, and laid on the surface of pastures.

Since the animal and vegetable manures are composed of the materials needed by growing plants, even to the very earths and salts, of which soils are said to be robbed, they must consequently afford the most valuable share of food to growing plants: but as the food, from its capability of being consumed by living vegetables, is continually diminishing, the consumption requires making up by periodical fresh applications.

Animal and vegetable manures being most generally employed for the enrichment of soils, it is useful to inquire what changes and consequences arise when they are thus devoted.

The usual method of application of farm-yard manure, is, by carting and spreading the materials on the surface of a field in an incipient state of decay, and then burying them in with the plough.

Experience proves that the decomposition of vegetable and animal manure is in proportion to the state of culture of the land to which it is given. If the field be in an exhausted state, and only one ploughing follows just to bury the manure; its decomposition, and chemical and mechanical union with the soil will be very slow, in consequence of

the undestroyed strong balance of affinities of the impoverished soil.

If the previous reasoning holds good, manure so employed is in part wasted, instead of being made the most of, as it is when put early on a fallow; because the manure when buried, lies in contact for a whole year, with precisely the same surfaces of the soil, and being in lumps, its sphere of contact must be proportionally small. The consequence is, that less fermentation takes place than what ought to do, and a proportion of the manure will actually escape in gas, from its own fermentation after the saturation of the contiguous particles of the soil has been completed, and the absence of more fresh particles to arrest it. If plants are growing above it, they are injured from the apoplexy and lodging of the corn that follows, by receiving this food too readily, and not sufficiently diluted, if I may be allowed this expression. This is the reason why fish manure, or yard manure is so soon gone when put on a field to be immediately cropped, and is not cultivated previously.

Stubbles ploughed in, will remain with very little decay for a whole year in poor and half cultivated lands, from the existence of the strong balance of affinities, resulting from the exposed particles being saturated, and no new ones brought up to the sun, air, &c.; therefore, no fresh combinations or fermentation can take place. Whereas, if stubbles

are ploughed in, preparatory to a fallow, so as to have the benefit of several successive ploughings and harrowings, nearly, or quite the whole of the stubble will be decomposed and blended with the soil, and be rendered a valuable manure, by the reciprocal fermentation of the land and the stubble. The former, set into activity by the cultivation; the latter, from its easy decompositions soon feeling the effect of the former, when they act conjointly in their general fermentative and fertilizing process.

When a crop is to be principally benefited by the manure laid on a field with one ploughing only, the manure should be rich, and in a forward state of decay; because its decay, when in a long state, will be unassisted by cultivation, and the affinities of the particles of the soil will be too strong in their balance to expedite the process. The manure, in this case, will require to be brought into that state of decay before it is applied, which will ensure its own fermentation afterwards without aid from cultivation. And then, like shavings or small wood to a nearly extinguished fire, a partial overthrow of the strong balance of affinities of the soil will be produced, and thus far restore its fertility. But when manuring in this way, it is at the expense of the manure itself, by the loss that necessarily ensues, whilst the heap lies fermenting in the mix-hill, in order to its being reduced to the requisite state of

decay: which decay, or rather calcination, causes a portion of its best elements and quantity to be evolved to the winds. Again, when the manure is laid on only before the last ploughing, even if it be a fallow, and a crop then sown, the manure is found distributed in the soil more or less in lumps. The young, and perhaps delicate plants, before they reach the manure with their fibres, must be some time, and during the interval many perish *. Such is the case with young turnips, which, when they do reach the manure, find the same in masses, and, from its very light and porous nature, not so well adapted for the roots to extract benefit from, as if blended with, or more divided in the soil.

The above circumstances lead to the conclusion, that, both in the garden and in the field, the best time and manner of applying vegetable and animal manures, indeed manures of every description, is on a fallow; and to cart and spread them on the land in the autumn, winter, or spring, according to their nature and circumstances; when there will be

* By the experience of the best gardeners, raw manure is never found so healthy for plants as when it has been digested and blended with the soil by a previous fermentation and cultivation; because the materials of the raw manure are forced, as it were, upon the plants in an unselected, undiluted, crude state; thus favouring disease, apoplexy, or extravagant fertility.

sufficient time to mechanically mix them well with the soil, by the successive ploughings and harrowings.

The only exception that can be adduced is on stiff clayey lands, which might have the coat of manure applied at twice to keep it the more open; as once at the fallow, being half the quantity, and once between, as for beans or peas.

By the manure, or manures, being so early applied, the particles of the soil are more quickly and generally divided, therefore the sooner and better able to admit the fresh air, rain, and dews: thus favouring their decomposition and union with the soil; and likewise the same of the manures, which, uniting in their effects, co-operate with the plough most powerfully in the general increase of fermentation and pulverization. The thermometer will always denote an increase of temperature when inserted into the soil about three inches, after recent cultivation, and also after recent manuring; and when these are both combined, the rise in the instrument will be found proportionally the higher. Under these favourable facts, it is not to be wondered at that the long strawey manure becomes soon reduced to a short fine state, and very generally distributed by the after cultivation.

Now, when any delicate seeds are sown on a field treated as proposed, they are assisted in their infant

vegetation by the increased native powers of fermentation in the early manured and well pulverized soil. Their first roots have the great advantage of the necessary food being immediately contiguous to them, and in that state of delicate suspension, or balance of their affinities, that the least vegetative effort of the plants is sufficient to overthrow, and in consequence such a tilth is most favourable to their unfolding, their future vigour, and their arriving perfect at maturity.

If the reasoning employed be correct, this favourable conclusion may be drawn, that the early application of vegetable, animal, and other manures to the fallow, contributes in a multiplied degree to the fertilizing the same, by the mechanical as well as chemical assistance which they impart to the power the soil has of combining with, and decomposing air and water, with, at the same time, their pulverizing effects; which objects could not be gained, if the manures were added only before the last ploughing, and, by this practice also, the four following points are gained. The first, considerable less loss in the manure or manures, by their fermenting in the soil, instead of in the mix-hill. The second, the soil deriving more fertility by the early application of the manures than when put on late, and at no expense. The third, the manures being carted on the land early, less loss ensues from eva-

poration, the sun having then less power. And the fourth, that if any kneading should take place during the carting, there is time afterwards to get the better of the evil, with having the manure, or manures themselves to assist the husbandman's efforts.

The application of the same kind of manure to plants or trees that are occupiers of the soil for more than one year, as hops, the artificial and natural grasses, fruit, &c., is not always advantageous, nor do the fields prove so productive as might be expected from the pains bestowed.

The advantage of variety is, greater fermentation; therefore, greater benefit from the air and rains. For the same manure acts on the soil, particularly if not aided by cultivation, like the same medicine, or the same air upon the human system, which medicine or air is found to lose its best effect after a too long repetition. In fact, the soil as well as the body, becomes saturated or neutralized. This is not the case with arable land, because of the variety of the crops, to say nothing of the cultivation, particularly of the fallow, which is the most powerful of all; and thus admits of the same kind of manure being applied periodically for ever with the same success.

Before the subject relating to manures is brought to a conclusion, it will be proper to observe, that an excess in manuring, particularly when put on

raw for the coming crop, is as injurious as when land is poor, from the want of manure. For of fertility there may be named three descriptions. As,

Extravagant fertility.
Productive fertility.
Apoplectic fertility.

The first is, when so early and rapid a decomposition takes place, that the plants thrive too fast in their youth, and then towards harvest have nearly or quite done growing, without perfecting their seeds. This is commonly known by the name of crops, being winter, or spring, proud, and summer poor.

On examining the stalks and ribbons, they will be found to be covered with the fungi species, which is owing to a sudden cessation of the supply of the sap; the healthy secretions are in consequence at an end, fermentation of the juices succeeds; a gas is then formed, which bursts the vessels, and the fungi grow.

The cause of this extravagant fertility is this: that the corn was sown upon fresh or recently manured land, the land being in itself poor from previous exhaustion: the result is, that the corn receives its food directly from the manure, in the first instance, and of course in an unselected, undiluted state, instead of disengaging it from the soil, with which the particles of the manure had been

lightly combined by previous good cultivation*: for the fresh manure decays faster, and thus yields and indeed rather forces itself upon the plants beyond what they naturally and immediately require. And being aided in its decomposition by the vegetative powers of the corn, a too rapid growth is at first brought on. Then, as the plants had been induced to commence their structure upon a large scale, by the abundance of the materials afforded them, they require a proportioned greater quantity of the same materials to maintain and complete what they had

* Very many proofs might be adduced in support, both by gardeners and agriculturists: for example, a field of good land was manured and sown with wheat, at the proper time; its appearance during winter, spring, and summer, was very strong: but when reaped at harvest, the straw was found very soft, the grain of little value and short in produce. The owner of the field was recommended to fallow it, although he himself conceived the field to be sufficiently fertile, as not to require such tillage: however, he had recourse to the fallow, and then sowed wheat again. The produce after the fallow treatment, amply repaid the expense, being more than six quarters upon the acre; a proof of the superiority of cultivation, over a coat of manure without it.

The process of fallowing had mixed and combined the manure with the soil, at the same time restored its chemical powers, and therefore the succeeding crop of wheat drew from its resources, now rendered healthy, in proportion as it required the food.

begun: but from the two-fold cause, of an early extravagance, and large structure, they find those materials deficient at the very time when wanted the most—the forming and completing of the seed. The soil, all the time, from its poverty, or strong balance of affinities, effects but little towards the growth of the plants; therefore, out of the two sources of fertility, namely, manure and good cultivation, the one most important, meaning the latter, having been neglected, fails of its necessary supply, and disease of the plant takes place accordingly *.

The cause of productive fertility is owing to a regular decomposition going forward within the reach of the roots of the growing plants, when food is yielded sufficiently fast to meet all their necessary demands, and continues thus from the beginning to the end, and a well matured crop is formed, yielding bright straw, a handsome plump sample, and in quantity proportioned to the native fertility of the land. This favourable result is to be attri-

* Corn sown upon scarified ground, and compared with the same species grown on the same land ploughed, will be found, when examined at harvest, to have its straw considerably softer and the grain not so abundant in produce, either in weight or measure; because the plants of the corn were not so well able to effect the requisite secretions for the composition of the straw, or the quantity of all the materials to form the grain, as where the roots could penetrate the greater depth into a more recently cultivated soil, as when after the operation of the plough.

buted to the crop being able to disengage its food from the particles of the soil, with which it has been combined by a previous good cultivation and exposure, or fallow process. The beneficial consequence of which, is, that the plants have to exert their own decomposing and selecting energies to obtain the food they require, and therefore, take up no more than what their healthy vegetation demands; instead, as in the former case, of having their vegetation impelled on, as it were, by the too rapid and overwhelming self-decomposition of the manure.

The cause of the apoplectic fertility is owing to a too rapid decomposition taking place throughout the growth of the plants, as is the case if a few clevels of grain happen to fall upon and take root in a dung mix-hill. The plants are seen to flourish away with uncommon vigour, as if in a state of intoxication, producing ribbon by wholesale; and if standing in masses, are soon beaten down by the winds and rain, when, the straw becoming bent, the sap is then more or less impeded in its flow through the vessels, which are already overcharged with half concocted food, forced into circulation by the too rapid decay of the manure beneath; the consequence is the bursting of some of the vessels, when a nidus is formed for the fungi species, in the form of red rust, &c., and if this corn ever ripens, a lean half formed clevel is the only produce.

CHAPTER V.

On the variation of crops.—The injurious tendency if not practised, and the benefits if attended to.—The causes why a variation is necessary, confirmed by experience.—A few similes relating to the above.

OF THE THIRD KNOWN FERTILIZER OF THE SOIL, OR MEANS OF GAINING PRODUCTIVE CROPS FROM THE LAND, NAMELY, BY THE VARIATION OF THOSE THAT SUCCEED.

It is often a remark of practical men, that the land is fresh to such a crop, not having grown the same species for some years before, and therefore is the chief cause of its present flourishing appearance.

To enter with propriety on the subject of this chapter, it will be necessary to ask the question, what takes place in the soil during the growth of any particular vegetable? The reply is, that a fermentation, with the extraction of certain proportions of the materials of a decomposible nature contained within the soil, is effected during the process of vegetation, and in a manner peculiar to the species grown.

Now, if the same grain, or vegetable, be sown the following year, the same precise fermentation and proportions must necessarily take place, and be required for the unfolding and perfecting of the same plant, and of course so continue to be the case for any number of years afterwards. What is the tendency of such a practice? Why, a rapid approximation to the strong balance of affinities, that is to say, to poverty and barrenness.

In this we are supported, most completely, by facts; because, in the space of a few years, the land that is continued to be sown with the same species of grain, will produce next to nothing, save the weeds, which are most congenial to the soil and circumstances; and these will spring up and flourish in an inverse ratio to the corn. If manure be added under the hope of improving the corn, the weeds being fresher to the soil than corn, will be the chief gainers, and flourish with proportioned vigour, choking up the crop the earlier. Certain soils will bear a repetition of one kind of corn longer than others, according to their constitution; in general, two good crops of the same species in succession are rarely obtained from the same land: but let the land be cropped by a different species every year for a few years together, the fermentation and extracted proportions will then be varied, according to the degrees of difference and pecu-

liarities of the description sown, and these degrees of difference are denoted by the peculiar marks of vigour of the growing plants. Adopting this practice, instead of growing one productive crop only, a succession of two, three, four or more, may be obtained to complete a series proportional to the judiciousness of the selected variety and the soil: when a recurrence of the succession may take place with due profit, and by employing proper cultivation conjoined with manure occasionally, be continued for ever; with the land improving through the two or three first series, when its limits of productiveness relative to the then management of the soil (saving the influence of seasons) will be obtained.

The advantages gained by the introduction of a variety in the succeeding crops, appears to be owing, in the first place, to some species rooting deep, others superficial, others again diagonal, and so forth; by which means, every part of the cultivated soil becomes investigated. In the second place, one plant may require a large proportion of oxygen, another of hydrogen, a third of carbon, and the like; to recollect each of which, for the healthy maintenance of each respective plant, requires an interval of two, three, four, or more years, according, of course, to circumstances. Supposing the interval of any species of corn be passed

over for a time, the consequence to be anticipated in the future crop of the same species, is, provided the land be kept in high cultivation all the while, that the vegetation of the plants will prove conspicuously fine and vigorous, and at harvest exceed the former crop of the same species, either in straw or corn, or both *.

Relative to the truth of all the above particulars, it is only necessary to attend to the analyzed products of a few species of vegetables, and we find a difference in the proportion of the materials of which they are composed, which, passing through their peculiar organization, causes that characteristic feature, their variety.

Experience has, indeed, a thousand times confirmed the necessity of a variation in the succeeding crops to a certain extent †. Consequently

* Plants, by their own vital powers, easily destroy the balance of affinities when lightly combined, which is the case in every fertile well-cultivated soil. They then extract, and employ to their own use, such proportions and materials as are necessary to their health and growth. But when a field becomes exhausted by excessive cropping, the vital powers of vegetating corn are unable any longer to overturn the then balance of affinities, and cultivation with manure must be had recourse to for the attainment of its ends.

† The variation of crops even in nurseries, orchards, and gardens, is found of the first importance. Nature always has recourse to variety when left to herself. In the forests

the best judgment of an agriculturist is required to select those useful species, which will follow each other most successfully; to ascertain also, the necessary interval of time of each respectively, before a repetition of the same course can take place, to ensure, on an average of years, the greatest permanent produce at the least expense. An agriculturist first entering on a farm, cannot be supposed to be well acquainted with its constitution, therefore, the benefit of a few years' experience, which is the surest analyzer of soils, must be had, before

of America, the soft wood timber when destroyed, is invariably succeeded by the hard wood timber, and vice versâ.

Again, Nature in her operations on pastures, or fields that are neglected and thrown on her hands, produces in succession, one fresh set, or species of plants after the other; that is to say, she has recourse to a variety of crops or plants, without which she cannot be prolific, or destroy the barren tendency of the increasing balance of affinities, from the maintenance of one species only. These plants succeed each other in order, being regulated by their respective powers of vegetation or hardiness. If such land be let alone, the late plants decay, and become food for those that succeed: and when the smaller species are not strong enough to grow, yield their places to the larger, and these become the nursery for the forest, which ultimately takes, and keeps possession of the soil; converting, by its superior vegetative powers, the unconsumed preceding productions, even to its nurses, to its own use and support.

their nature and peculiarities can be known, and a permanent profitable produce gained.

Similes being generally great elucidators, the recourse to them will therefore assist in explaining more clearly some parts of the reasoning employed in this chapter.

Let a piece of fresh burnt lime have a little water thrown upon it; after a minute or two a chemical process commences, which exhibits itself by the lime-stone breaking to pieces, the vanishing of the water, accompanied with the evolution of heat and steam; when all is again quiet. A little more water being thrown on, the same process and result ensues, which may be repeated till the whole mass is saturated with water, and converted into the hydrate of lime, when the balance of affinities being established, no further decomposition and evolution of heat will take place, whatever quantity of water may be afterwards applied. This hydrate of lime may be dissolved, and with the addition of sand form mortar, or be mechanically suspended in a body of water; but the recurrence of the same phænomena is impossible, until the hydrate has been exposed to the fire of a furnace to re-expel the water, when the same appearances will be visible on a second application of water.

Again, let the hydrate of lime be exposed to the influence of carbonic acid, the hydrate will in due

time become the carbonate of lime, for this acid, having a stronger affinity for lime than water, expels the water and combines with the lime. During this change, a different fermentation goes on from the former, and continues till the lime is saturated with the acid, when all is again quiet. But let a third substance be applied to the carbonate of lime, as the muriatic acid, which has a stronger affinity for lime than the carbonic acid; this acid will, in its turn, dislodge the carbonic acid, by a strong and rapid effervescence, till the balance is once more established, and the carbonate changed to the muriate of lime, when no further addition of the same acid will have effect.

Suppose, however, the sulphuric acid be next employed which, from its superior strength over the muriatic, will then take place of the same, and form the sulphate of lime. Having gone through this series, the furnace being again had recourse to, the lime may be once more obtained pure, and all the before mentioned phænomena, like a course of crops, can be practised and seen a second, a third or more times.

CHAPTER VI.

On the benefit of laying land, for a time, down to grass.—The causes of the benefit.—How pasture improves land.—Land should be laid down to pasture in a good state, &c., for much to be expected from it when broken up again.—The propriety of paring and burning the turf of old pastures, as the first step when breaking them up.—When burning turf, the temperature not to exceed a certain degree.—What crops will grow on old unburnt pastures: but it is best policy to pare and burn first, then fallow, &c., before attempting to grow a crop.

THE fourth fertilizer and restorer of land to bear productive crops, is, by laying it down with any of the artificial or common grasses, for one, two, or more years; then ploughing the same up again for corn.

The advantages obtained from the practice of devoting arable land occasionally, or periodically, to pasture, are incontestible, and are derived from two causes.

The first is, that the artificial and common grasses being in their nature distinct from grain crops, the decomposition or the exercise of their affinities, and the required proportions of the elements of vegetables, must be equally as distinct.

On instancing any of the clovers, sainfoin, and lucerne, we observe they send down their main roots deep into the soil, therefore, acquire a large share of their support from a stratum lower than the generality of corn: nevertheless, their side roots, penetrating just under the surface, collect those other necessary proportions of nourishment contained in the soil, which they do with facility in the first instance, because the land is fresh to their efforts by their exerting affinities different from the roots of corn. After a few years these grasses grow stale to the land, and their efforts cease to be so successful as when they were first exerted; and from this cause produce less and less, according to the nature of the plants.

In the same degree the land recovers its freshness for corn; which, when again sown, yields with redoubled increase: but since some of the grasses, ray-grass as one, approach very near to the nature of wheat, oats, and barley, they cannot, on that account, effect so great a change, therefore, yield a less favourable season for wheat, oats, and barley, than if they were more opposite in their distinctive qualities.

The second cause of advantage is from the turf, the dead leaves and stems. These latter, during the formation of the turf, falling down among the

live stems and roots, create in time, by their decay, a stratum of dark mould from the charcoal yielded by the decomposition of the vegetable substances; and which decay is promoted by the close shade of the growing plants.

Grass, whenever it takes root, begins forming a mould beneath of a vegetable or decomposible nature, and therefore must, from this circumstance, acquire a part of its nourishment from the atmosphere, or this collection could not be made, except what the plant may retain of all dust or soil fortuitously dropt, and the excrement of animals*; and with these establishes itself stronger and stronger. This mould gets more and more blended with the soil by the rains and frosts, the workings

* Also the benefit derived from their treading the ground. The treading acts, in the first place, as a species of cultivation, by the particles of the surface being thus made to change their position in a greater or less degree; and in the second, by the stopping up and changing repeatedly, in consequence of the treading, the old and saturated water, air, and insect ways, when the succeeding showers, &c., are the longer retained about the roots of the grass, to their greater advantage, particularly on all dry soils, which should be fed, for this reason, with heavy stock, in preference to light. This is one chief cause why the feeding of pastures is more profitable than mowing them, and the use of well rolling those intended to be mown.

of insects and worms, proportional to the time it is suffered to remain unbroken up; but when done, and ploughed under, proves a coat of manure.

These, then, are the two causes of benefit arising from returning, for a period, arable land to grass. It is right, however, to observe that in so doing, and with the real view to the land's improvement, as well as to its present and future profits, the previous treatment must necessarily be taken into consideration, likewise the management it ought to receive when in a state of pasture: because, if the grasses are sown upon an exhausted, foul tilth, neither the immediate nor the future produce can be great. Again, if the produce of the pasture, the result of a good preparation, be carted off for green food, hay, or seed, and no manure brought back, the corn crops will disappoint the expectations of the husbandman, whenever he returns it to arable.

It is the fact, that land is like an animal fattening; the better and more liberally it is treated, the heavier and more valuable will be the profits; and the husbandman should also bear in mind continually, that out of nothing something cannot come; therefore, if he is desirous of having large and profitable crops of corn when his lays are broken up, his plan must be to sow his grasses on a fallow*, or very near to one, and then feed off the produce; or ma-

* See A. Young's Calendar.

nure liberally, if the hay or seed be more valuable to him disposed of elsewhere, when his anticipations will be as liberally realized.

In some districts, the first step towards the breaking up of lays, especially when old, is to pare and burn the immediate surface. To an inexperienced observer, such proceeding would certainly appear rash, since he would naturally say, the fire must destroy the greater part of the valuable vegetable materials that had accumulated during the time the land was under grass. From the continual practice, however, of paring and burning with a positive benefit, it appears nearly certain that there cannot be the loss persons, on a first inspection, might with justice suppose; or if there is, it is more than compensated for in another way. To be satisfied on this point, the merits and particulars of the paring and burning system should be examined.

Thus, when a turf has been forming for a few years, it becomes a most favourable nursery for insects and worms, which, on the breaking up again of the land, are ready to invade the fruits of the husbandman, by instantly devouring any thing he may sow, when in the state of youthful vegetation, and in consequence defeat his object in a greater or less degree, however rich the land may be. To obviate this great evil, nothing presents so effectual a remedy as the paring and burning of the turf, which

destroys, in the most certain and expeditious manner, all insects, eggs, and worms contained therein. But clover and grass lays, of only one year's standing, do not require to be pared and burnt, since the injurious effects from insects are of little or no moment, and their roots will decay during the growth of the succeeding crop, affording a healthy, because gradual, supply of nourishment.

If the land, during the state of pasture, be neglected as to the seeding of weeds, the fire of course destroys them. Again, very old and neglected lays are frequently filled with the woody roots of broom, furze, and trees, that, from their solid nature, require years of common cultivation to decompose, and with land that is at all poor, the balance of affinities is even too strong to decay, readily, the turfs of grass, when ploughed under; which, with the woody roots, roll about under the harrows and plough for years afterwards, preventing the healthy growth of corn, by the too great hollowness they occasion to the soil, at the same time existing for the first year or two, as a mass of rubbish of half alive, half dead turf; which not only continually robs the corn of nourishment, but keeps in existence all insects and worms, and exhibits to the eye, after harvest, a worse surface for the plough to manage than before it was broken up. To remove the above evils, fire is the best agent.

Thus far, the importance of paring and burning all old lays is manifest. The next enquiry should be, whether land derives assistance from the ashes as a manure.

Concerning the burning of the turf, experience confirms the propriety of not carrying the heat of the fire to too high a temperature, and the criterion of able practitioners is, when the soil that is calcined with the turf is black; for to carry the heat so far as to burn the earth red, they are satisfied is a loss, not only in the combustible materials, but injurious to the earth burnt, particularly if a clay, by its being rendered little better than a stone. In fact, with turf, roots, &c., the true object is just to break down their texture by a gentle combustion, to avoid dissipating their gaseous materials any more than is necessary to maintain the fire, at the same time keeping the small heaps covered, by throwing on, with judgment, a portion of the adjoining soil, which may arrest and combine with as large a portion as possible of the soot or whatever else arises in the form of gas with the smoke. By this means, nearly a cart-load at each heap is formed of dry, powdery materials, containing soot, wood ashes, charcoal, and blackened earth; which, together, form an excellent manure for all poor and fresh broken up lands.

The question now is, how do the ashes act as a

manure? These ashes having had their old affinities completely overturned by the fire, and their new ones, which are most active when immediately applied in their warm fresh state to the soil, act in part as lime, and in part as vegetable manure; and with a judicious tillage directly following, a strong fermentation takes place, and thus the fertilizing process commences*.

* The applying of hot ashes to the soil from which they have been pared and burnt, and immediately burying them with the plough, is of very great importance, because, even the best lands when first broken up from a state of pasture of only a few years' standing, are found extremely altered as respects their fitness to bear at once delicate vegetables; consequently, the poorer lands must be in a much worse condition. The case is, that land of any description which has lain unexposed to the sun, air, rains and frosts, for a few years, becomes raw, harsh, and cloddy, with all its former silkiness or delicate tenacity, or the easy yielding to the least touch of the foot gone. If a piece of earth be taken from under the turf and examined in the hand, it will be found porous, from the road-ways of worms, insects, and decayed roots; also cold, raw, and hard, and bound together by the living fibres of the late grass; having its affinities in so strong a state of balance, in consequence of the same species of plant growing for a series of years on its surface, that a clod of it, which is little better than a stone until thoroughly reduced by the seasons and the plough, will resist decay and change for a length of time.

Whilst the land is in the above state, it is physically im-

The above aids are required because the only ve-

possible for it to afford nourishment to the roots of any plants requiring nice cultivation; because, if sown upon it, the soil is too hard to admit the tender infant roots within those parts that have not been already searched by the roots of grass; and where they have traversed, they have effected so strong a balance, that the roots of the delicate fresh plants are able to obtain only the smallest nourishment: also, the former roots, rains, and worms, having left the soil hollow and porous, the succeeding rains, instead of being absorbed and thus retained by the soil, do, in a great measure, escape through the old channels. Now these water courses presenting only old saturated surfaces to the contact of fresh showers, arrest no new fertility, and what fresh air may gain access to the interior, by following the vanishing water through the soil, only meets with the same old chambers whose sides have long since been saturated. From these causes, every fertilizing shower that falls, may be said to be lost; little or no fermentation takes place after it, or there is a complete stand-still, and therefore no food is yielded to the infant plants: with their decomposing powers too weak to gain support by decaying the old grass roots, they consequently die. The old grass roots, thus left, remain in a state of comparative preservation, till some more powerful vegetable grows above them, or tillage and manure effect their overthrow. The seed sown might, and indeed does, grow at first from its own resources, and from the air and moisture within its immediate neighbourhood; but the plants, if they come up, soon afterwards present to the eye a stand-still of all further growth, maintaining a mere existence by the falling of a few timely showers; then perish.

getables of the edible and corn kinds that have sufficient decomposing powers to succeed, even on good lands, when first broken up from a pasture, are the hardy sorts of the potatoe, the tare, and the common gray pea. But it certainly is better not to plant or sow any crop on fresh broken up land until it has been properly prepared by the fallow tillage, and manured with ashes, &c.; because the depriving the land of the energies it may possess when broken up, retards the progress of its after-improvement, in a more than two-fold degree.

CHAPTER VII.

On draining.—Cause of the benefit of draining.—On irgation; the success of it attributed to what principles.—The art of irrigation consists in imitating nature.—The success of the art in Egypt.—How the first class of plants form food for others of a superior description.—Why irrigation does not answer in Great Britain.

ON DRAINING AND IRRIGATION.

THE object of draining is to remove that constant quantity of stagnated water, to which some lands, under certain circumstances, are subject. The evil proceeds from the excess and the stagnation of water in and upon land; because such stagnation, by preventing the possibility of an exchange and an alternating of fresh air and fresh water, causes the balance of affinities to take place: for, by the water remaining without change, all its freshness or vital principle, like air once inhaled into the lungs, vanishes, and with it all means of fermentation: in consequence, the roots of plants growing in such a soil, become exactly similar to a bunch of flowers which h[illegible]t into a vessel of water, and the

water suffered to remain unchanged for forty-eight hours; or like an animal confined under an air-tight jar, when, after breathing for a few moments, it falls down and would expire if fresh air were not immediately admitted.

This is the reason why the excess and the stagnation of water destroys or prevents vegetation; and, of course, explains the cause of the astonishing increase of the fertility in those lands that have been properly drained: for when this is done, and the stagnated and abundant water removed, the alternate showers and sunshine, which are so beneficial upon other lands, prove equally as advantageous on these *.

As respects irrigation; the success, incident to this art, is to be attributed to the same principles as

* With regard to the bringing of boggy land into cultivation, the first operation must be a thorough draining. Such soils are a complete mass of vegetable matter, maintained in a balance of strong affinities, by the tanning and acid principles contained within: and these principles are cherished in their existence by the excess of wet, which, together, positively preserves the peat for ages so completely in an undecayed state, that neither the decomposing power of growing vegetables, nor the pulverizing effects of the plough, will overthrow. Nothing, therefore, can be done without a thorough draining, to remove the preservative property of excessive wet; and next, by fire, to destroy the strong balance of affinities, as far as the tanning and acid principles are

mentioned under draining: that is to say, the evil complained of, in land requiring irrigation, is from the opposite extreme, the excess of dryness, proceeding either from climate or circumstances of soil and situation, or both. This excess of dryness produces the same torpidity in the soil as the excess of wet, by the air, in this case, being stagnated and stale within it; thus preventing all fermentation, as far as its proportion is necessary, with the evil of the entire absence of fresh water.

By irrigating such land, fresh water is, in the first instance, admitted to the soil, therefore, to the roots of the plants, the water, as it passes into the interstices of the land, expels the stale and stagnated air from the interior, and fermentation, with corresponding vegetation, soon succeeds. But if the water be suffered to occupy the soil for a time, particularly in a cold climate, so that the fresh air cannot be again re-admitted, the evils incident to land wanting draining will here equally ensue; therefore, showing the propriety of permitting the flow of water for a few hours a day, or a week, only; then stopping awhile for it to subside and be absorbed, that fresh air may occupy its place, also for a few hours, a day, &c., when the water may be again re-admitted with a certainty of benefit.

As to regulating the quantities and periods, in carrying on this alternating of fresh air and fresh

water; they are to be learnt by paying attention to the progress and the healthy appearance of the plant's vegetation; lest that be suspended too long from the extremes of either wet or drought.

The art of irrigation properly consists in imitating Nature in her alternate showers and sunshine: or, the gardener's practice, in his waterings of his hot-house and green-house plants.

In support of the argument used relative to irrigation as it may afford food for plants, the success of this art in many countries, particularly on the blowing sands of Egypt, may be most aptly introduced.

These blowing sands are found productive in proportion to their contiguity to springs of water, and as far as the line of perpetual wet. In crossing the deserts, the neighbourhood of springs is always indicated by the appearance of vegetation: for the water, in this instance, on the same principles before given, running from the springs into the sand during the cold night, expels the air contained within, and then, on the following hot day, is itself more or less consumed by the influence of the sun, and in the support of those growing vegetables that are suitable to such situations, when the vacancies, left by the absorbed water, are filled with fresh air, which, in its turn, is respired by the roots. In this manner is an healthy vegetation carried on, from the alternate supply of fresh water, and fresh air, only.

Thus is the first class of plants maintained; these, by their decay, supply the materials, conjoined with air and water, to the second; these again to the third; till, by the practice of irrigation, manuring, and cultivation, under the direction of intelligent man, food is not only raised in abundance for himself, but for other animals also.

The marks of a former irrigation and cultivation on the banks of the Nile is apparent to the eye of the present traveller; but, from neglect, the land, once so fruitful, is now nothing more than a wilderness of blowing sand*: therefore, proving the nourishment, for the support of those harvests we read of, was nought but a decomposing, gaseous substance, or some remains must be visible at this day; but nothing is left except the primitive sand. It is natural then to conclude that air, water, and decayed vegetables, with the excrement of animals, was the support, as it has been shown to be the case now, which produced such abundant harvests.

Irrigation is sometimes had recourse to in Great Britain; but in consequence of the climate, conjoined, perhaps, with improper management, the produce, if grass, possesses very little of the fatten-

* "Where are those husbandmen, those harvests, that picture of animated nature of which the earth seemed proud?" Volney's Ruins, p. 7

ing quality, though, from the abundance of the keep, there appears every reason to expect otherwise. The same, if practised with corn. This very evil took place from the quantity of rain that fell in the south-east part of England during the year 1824; for the grass and hay were never more abundant, but the improvement of the fattening stock by no means answered the expectation of their owners. And the corn also, particularly wheat, was a burden of straw, but the grain yielded far short of the preceding year's growth.

The cause of all this is to be attributed to the wet being too great for our climate; the power of whose sun was insufficient to evaporate the excess, and induce a healthy fermentation and vegetation.

It is not intended to enter into a detail of the practical part of draining and irrigation, as it is to be met with in most books on modern agriculture*.

* See Dr. Dickson's Farmer's Companion, and other works.

CHAPTER VIII.

On the nature and vegetative powers of the different plants usually cultivated in the field.—The list.—Of the turnip, mangel-wurzel, rape, potatoe—a digression on woods.—Of the bean, pea, tare, wheat.—The depths of ploughing land.—Of the oat, barley, clover, trefoil, sainfoin.—On the cultivation of drilled crops.—Weeds are robbers of fertility.

HAVING enquired into and reflected upon the principles of the food of plants and fertilization; nothing now remains to be done but to lay down, with the assistance of these principles, a judicious system of, or courses of crops. In the attempt to do this, much of the practical part of husbandry * will be necessarily introduced, and with occasional repetitions; but it is hoped without proving either detrimental to the subject, or tedious to the reader.

Keeping in mind what has gone before, a view must first be taken of the nature and the degrees of the vegetative powers of the different plants usually cultivated; for on this foundation the

* For further particulars, see A. Young, Dr. Dickson's Farmer's Companion, and Banister's Synopsis.

courses of crops should be formed, and will occupy this chapter.

ROOTS.	CORN.	GRASSES.
TURNIPS.	BEANS.	CLOVERS.
MANGEL-WURZEL.	PEAS.	TREFOIL.
RAPE.	TARES.	SAINFOIN.
POTATOES.	WHEAT.	
	OATS.	
	BARLEY.	

OF TURNIPS.

The turnip is a bulbous rooted plant with a large leafy top. It is particularly tender in its earlier state of vegetation, when it is very liable to be destroyed by an insect called the turnip-fly. Its growth, slow at first, is rapid through the two or three following months; therefore for art to keep pace and assist nature at that period, as well as to impel it beyond the reach of the fly, a large share of fertility is required at the time of sowing, which is best obtained by a well manured fallow; and as a further aid, the hand hoe, the horse hoe, (and perhaps the plough, as in Northumberland,) should be employed; as they are all practicable under the drill, or row system. For cultivation, as we have elsewhere observed, promotes fermentation, and thus assists the plant in the attainment of it

and in the necessary proportions, particularly if the manure be applied late and very raw; because from a deficiency in any of these proportions, disease and bad flavour are more or less the consequence. And further if its growth be checked in its earliest stages the root seldom attains the requisite size.

Turnips of all kinds should be early thinned, from one to two feet square, when in four or six months they will acquire their full dimensions. This thinning, however, is necessarily regulated by the goodness and badness of the land, and the tilth, for the root varies in its weight from one pound to twelve.

The vegetative properties of turnips, though delicate in the first instance, are certainly strong as respects their decomposing powers and health in highly manured land, which can seldom be made too fertile for them. Apoplexy, or the evil of excessive fertility, which is destructive to straw corn, is, by the plants in question, effectually guarded against, in the expansibility of their root and top, both increasing in healthy magnitude in proportion to the nourishment they receive.

The fresher land is on which turnips are sown, particularly if a sandy loam, which they most prefer, (provided the tilth is in high condition and no worm,) the more flourishing will be the crop; an interval, therefore, of a few years, as four, but better

if six or eight, between the sowing of one crop of this root, to that of another, is unquestionably necessary. In Norfolk, the agriculturists find more difficulty now to raise a crop of turnips with manure, than they experienced on their first introduction without.

As cultivation is so advantageous to this root in its early stages, the drill or row system, in comparison with the broad-cast, must on this account be the best.

MANGEL-WURZEL.

For this root the land should be rich with manure and in a fine pulverized state; the fresher of course the better, provided there are no insects. It is hardier than the turnip in its first vegetation, but will not bear the winter's frosts, and the plants should be thinned out in the young state to the distance of at least eighteen to twenty-four inches square; or, which is greatly to be preferred, left in rows eighteen or twelve inches one way, and three or four feet the other. The vegetative or decomposing powers of this root are strong when once established in the land, which can seldom be too fertile, provided it is accompanied with the requisite cultivation, when it will continue in health, having the ability of enlargement in its root and top, to keep pace with the vigour of the soil. The growth

of mangel-wurzel is slower than the turnip, particularly at first, and as insects in the fly state rarely attack it, the necessity of cultivation, when the plants are up and large enough, is not so immediate as with the latter root.

RAPE.

Rape is a plant more hardy than the turnip, and less liable to destruction by the fly, and to be productive does not require a well manured fallow. It has not a bulbous root, being of the broccoli species, instead of which, the plant shoots up a large stem and top, and both are capable of expansion with full health as the land may be good or bad, therefore is suitable to all strong lodging soils; is rapid in its early stages, and the manure of raw dung is no injury to its decomposing powers, as they are of sufficient strength to surmount the evil. The seed is usually sown broad-cast and thick, to check the excess of its vegetation as to height, that sheep may consume it the easier. It is frequently grown upon lands on which there would be less chance of success with the turnip.

OF THE POTATOE.

The potatoe exceeds every other root used as food, both in its vegetative and decomposing

powers. It will grow and be productive on almost every soil, either in a stale and run out condition, or fresh broken up from a pasture with the turf remaining, as the attacks of insects are seldom fatal to it.

The superiority of this root, as respects the object of its propagation over those which are raised from the seed only, is certainly great, and is according to the nourishment contained in a bulbous root to that in a seed. For the bulb root supplies a large share of immediate food to the rising plant independent of the soil; thus affording strength and time for the fibres to well establish themselves in the ground, when they can then procure their after support from that source. Whereas, the seed of the turnip, &c., and even of the potatoe itself, having so much less of immediate food for its respective plant than the bulb, requires that deficiency to be made up by the superior fertility of the tilth each sort of seed is sown upon; consequently, it is this cause which renders the potatoe, in its bulb state, so hardy as even to flourish in a bog if previously well drained, and be the means of bringing land which was before in a state of barrenness—yet replete with vegetable materials—into comparative fertility.

From the circumstance of this root being capable of flourishing on land too poor to raise many sorts of seed plants, it has the power of occasioning

greater fermentation and greater decomposition than they have, consequently extracting more nourishment, and thus deteriorating a soil in a much greater degree; particularly if a clay, by decomposing those more durable vegetable substances which tended to keep the particles of such land hollow and more friable; which generally remained undecomposed by the roots of corn, as they are not of sufficient strength to effect the overthrow of their affinities or induce decay. To guard against this evil, it is only necessary to previously well manure the field, that the staple of the land and the succeeding crops of corn may not be injured; for the roots of the potatoe will always consume that food first which is most easy of selection. With this care, the potatoe may be grown with perfect safety and success on all corn lands.

From the superior vegetative powers of this root, and its nature of increasing its bulbs in size and number as well as in length of bine, it is every way calculated for land in a state of extravagant fertility, on which, if corn be grown, nothing but straw could be anticipated; yet, by growing this plant one or two years in succession, a productive crop of oats or wheat, provided there is no worm, may with a degree of certainty follow. In fact, the potatoe will almost flourish upon a dung mixhill.

There is another extraordinary quality in this

valuable root, and indeed may be said to be peculiar to it, namely, that it may be planted on the land which is favourable to its growth for years together, without apparent deterioration to either; the cause of course proceeding from its strong vegetative powers. Instances of the above fact are to be met with in every cottage garden; and in one, the same species has been planted successively for thirteen years, a small quantity of manure being applied to the land every spring, yet the garden is apparently as productive, and the roots as fine as when first grown.

This fact, of the potatoe growing productively for successive years on the same land with a small quantity of manure each spring, leads to a digression for a few moments from the present subject, as it explains the cause why woods flourish for ages without a change of soil; having as their annual manure, the autumnal coat of leaves only, which the trees themselves furnish. It is this; that the thick coat of leaves, the variety of the seasons, the shade and shelter by which the leaves are protected from the effects of the too drying sun and wind, and the very strong powers of vegetation in forest trees, all operating together, insure that continual degree of fermentation in the neighbourhood of the roots, sufficient to afford, by the consequent decomposition

of air, water, and the leaves, the necessary supply of food.

The scale of growth in trees is, however, regulated, like corn, by the natural goodness of the soil; they are also susceptible of improvement by cultivation and by a variation, particularly when young, before they can sufficiently shade the ground with their tops and leaves to cause the requisite fermentation; therefore art, by introducing cultivation at that delicate period, effects that decomposition so much wanted.

A change of soil, by forming new plantations, is also clearly conspicuous in their aftergrowth, especially if the land be trenched before planting. Trees of the fruit kinds, as the apple, cherry, pear, &c., ought always to be varied when worn out, that is to say, let an old orchard of apples be succeeded by a young one of cherries; that, by a young one of pears, then plums, to apples again.

Nursery-men always make a point of changing or varying their crops of young trees in their nurseries. When they have disposed of a bed of young trees of any kind they always well dig, if not trench the ground, manure it, and then plant trees or shrubs of quite a different species from those growing there before, because they have experienced over and over again, the great advantages of change.

To return to the subject. The potatoe being a plant of the strength we have described, is an excellent fallow crop to cleanse rich foul land; for few weeds can overpower it, at the same time admitting of every species of cultivation to extirpate those that may exist.

With respect to the cultivation of this plant, it flourishes in proportion to the goodness of the tilth, and the quantity of manure combined; for the more mellow and tender the soil, and where sand predominates, the easier it can obtain its nourishment and expand its bulbs. It should be always planted ten to twelve inches asunder in the rows, and these from two or three feet distance, to admit of the hoe and plough cultivation between; these implements going deep and close to the plants at first, then shallower and farther afterwards, lest the fibres and young stringy roots should get injured.

OF THE BEAN.

This plant, of which there are varieties, grows from two to five feet high, having a stout and leafy stem, supported by a strong deep tap root. Arriving at a certain age, it begins to put forth blossoms and pods at every succeeding leaf-branch, which it continues to do as it advances, whilst there is sufficient nourishment and sun to support and ripen them.

The average produce on an acre is from three to six quarters. It is rather of slow growth, seldom falls a sacrifice to insects, and its vegetative power, although strong, is, however, incapable of yielding much return on poor light lands.

From this feature of the bean as far as relates to its soil and culture, it is evident that its nature is exactly calculated for all deep, clayey, fertile loams, because it possesses the means within itself, by its power of vegetation, its throwing out abundance of blossoms, pods, and the lengthening of its stem in proportion to the food it receives, to escape in a great degree the evils of extravagant fertility. Also its strong tap root, its large upright and ligneous stalk, point out the practicability of a close cultivation round its root, and the propriety of allowing good space for each plant to grow, that the blossoms and pods may receive the due influence of the sun and air.

Of the two modes of husbandry, the broad-cast and the drill or row system to which the bean is subject, the latter is certainly the one most appropriate, because it not only admits of room for cultivation whilst the crop is on the ground, but space also for the free circulation of the air, with the least interception of the rays of the sun.

In those districts where the nature of the bean is fully understood, the drill husbandry generally prevails, and the benefits arising from its practice are

such that this pulse forms a comparative fallow crop, indeed always a cleansing one, for oats, barley, but particularly for wheat to follow, as the season after beans is found peculiarly congenial for that valuable grain, since the same soil is the favourite of both, and the horse-hoeing cultivation which is given to the former, prepares an enriched and clean tilth for the latter.

The distance of the drills from each other, and the quantity of seed for an acre, depends on the fertility of the soil and the species of bean; say for the distance twelve to thirty inches, and as respects the quantity of seed, two bushels and a half of the small bean, to four and five bushels of the large.

The favourite season for the bean is a few crops removed from a well cultivated and manured fallow, and the soil a clayey loam, as it requires a rich, fresh, close land, in which necessary closeness the fallow is deficient, and consequently proves too light a season for this plant. Raw manure is certainly digested by the bean, particularly when the horse-hoe is employed; but on loamy soils it is liable to impel on its growth too quickly, with the attendant evil of more straw than corn; thus proving its vegetative powers not so strong, therefore not so proper to be sown upon fresh manured land as the bulbous rooted plants.

Stiff soils are an exception, for fresh manure removes in part the too great tenacity of clays to the advantage of the bean. Another exception may be adduced, but which would never hold good on a well managed farm; it is on land very poor.

The evil of loams producing too much straw on farms where manure abounds, may be mitigated by selecting that species of bean which is of the dwarf kind, and of quick growth; as for instance the mazagan, which should be put in rows twenty inches asunder, and at the rate of four bushels of seed to the acre.

Land designed for beans, should be ploughed up deep and rough in the autumn, the early part of the winter, or just after Christmas, according to the natural wetness or dryness of the soil, that the frosts may have sufficient influence to pulverize the clods, which, in the month of March, will readily yield to the harrows, when the crop should be put in.

It may here be asked, respecting land designed for a crop in the spring, and ploughed up the autumn or winter before, whether it be necessary to first replough the same? From what has been shown in the preceding chapters it appears that if the field be intended for very early sowing, the reploughing of it would not only prove unnecessary, but injurious; because, in the first instance, the

surface exposed all the winter, is in a mellow, pulverized, yet moist state, which, on being turned under by the plough, would of course be lost, and in all probability exchanged for one wet, close, and every way uncongenial to sow upon. In the second instance, as the end of the winter months and the beginning of those of spring are usually wet and cold, the escape of moisture in the soil through the winter water-ways, rather than the detainment by their destruction from another ploughing, is to be preferred, lest the seed sown at that period be deposited in too wet a bed, and thus occasion its decay.

The case, however, is widely different when a field winter ploughed is not intended to be sown till late in the spring; for the weather and land being then dry, the re-ploughing of it proves a real advantage. First, a dry pulverized surface is turned under; and since drought is at this season to be more guarded against than rain, the economising of every shower becomes necessary, and which of course is best accomplished by the doing away the water-ways of the preceding winter. Again, the season being advanced, every aid should, in consequence, be given to hasten forward the vegetation of the late sown crop, as by increasing the vigour of the soil's fermentation, which an extra ploughing effects.

OF THE PEA.

The pea is a pulse, and in its nature is more delicate than the bean.

There are varieties of this plant, all of which have a long, tender, tap root, and produce a bine from one to five feet in height. On this bine are the blossoms and seed pods, which grow out at each successive leaf joint as the plant advances. In consequence of the slender make of the haum, it is unable to support itself long in an erect posture, and therefore soon falls upon the ground, and again turns up its head. It is in fact a climbing plant. It is more delicate than the bean, of quicker growth, but its powers of vegetation not so strong.

The conclusion to be drawn from this is, that the pea requires a lighter soil than the bean, and one as rich in fertility. The favourite soil and season for the pea, is a deep tender loam, a few crops removed from a manured fallow, and the fresher the land the better. Its blossoms and pods are produced and arranged on branches at the sides of the haum; and for these to have the benefit of the sun and air, a sufficient space must be allowed for this purpose; and as the tap root of the pea is long, and performs the same offices as that of the bean, the same species of row culture is required.

In those districts where the pea is much grown, the practice is always to put this crop in rows from one to three feet apart, and at the rate of three to four bushels of seed to an acre, employing the hand and horse hoe between the rows to well cultivate the soil and keep all clear from weeds.

The pea as a fallow crop, is inferior to the bean; because the bine by early reclining upon the ground prevents the same continuance of horse-hoeing: when the weeds, if on a foul tilth, soon show themselves, to the injury of the crop and to the annoyance of the husbandman.

Oats and barley are better crops to succeed the pea than wheat, except on very stiff lands, on account of the soil being rather too much lightened for wheat by the pea.

The decomposing powers of this pulse relative to manure, are not so strong as those of the bean, therefore less calculated to be drilled directly upon the same. It is more liable to be injured by extravagant fertility, and consequently producing, under such circumstances, a burden of straw, rather than a crop of corn.

The average produce of the pea upon an acre, is from two quarters to four.

OF THE TARE.

The tare is a pulse of the pea species. Its ve-

getative powers are superior both to the pea and bean, being productive on lands too poor for them.

There are two sorts, the winter and the spring; the former is the hardiest, but both are equally useful in their proper season. This plant may be considered as a link between corn crops and the artificial grasses, since it may be grown and applied to either purpose most congenial to the wants of the agriculturists or the nature of the soil. In consequence of this quality of the tare, and its strong vegetative powers, it ranks among one of the most valuable plants grown. It may be profitably raised upon poor gravelly or clayey soils, on fresh broken up lays, as well as on lands of the most fertile quality, with the certainty of a fair produce on the former, and without the least fear from excessive fertility on the latter, except when required for seed.

When the tare is intended for food in the green, or hay state, it should be sown broad cast at the rate of three bushels to the acre; but if to produce seed, two bushels are sufficient. Should the drill be employed, from a foot to twenty inches will be wide enough for the rows.

The tare grows in length from three to six feet, producing blossoms and pods after the manner of the pea, but on a smaller haum, and therefore proportionally the more recumbent.

The average produce on an acre is from one to three quarters, and the crop may be manured or not. The tare will follow any crop for food, but when intended for seed, should, like the pea, be put on moderate land a few crops removed from a manured fallow, to be succeeded by wheat, oats, or barley, the soil being stiff, moderate, or light. The tare lightens land considerably.

It being the practice as well as the interest of farmers to cultivate between wide drilled crops, a few remarks relating to them will not perhaps be out of place here. This cultivation is generally repeated three or four times during the summer; the implements being a rake, hoe, and spade in the garden, and a hoe, horse hoe, and plough in the field, and is best done in fine dry weather. The cause of the benefit proceeds, first, from the destruction of weeds; next, from the greater quantity of nourishment yielded (as before shown), in consequence of the increased fermentation and the doing away, three or four times over, of the saturated water and air channels according to the depth of the cultivation, and is always of particular use on light dry soils. A rolled, close, and seldom moved surface cannot be so favourable for plants of quick growth, as one often pulverized.

With regard to weeds, they are always robbers of fertility. They are, however, sometimes of ser-

vice among wheat on land disposed to throw out too much straw, by their moderating the excess of the fertility of such a soil; but then, this crop ought not to have been sown on land so rich, until the excess of it had been previously removed by one or two crops of another kind, which would have effectually remedied the evil, at a greater return of profit.

OF WHEAT.

This is the most nourishing of grains, and in consequence is the favourite food of man. Wheat is a culminiferous plant, bearing its seed at the top of one or more stems of straw, three to five feet high. It is of the grass species, and like that has numerous horizontal fibres, and a long, fine, tap root.

As respects the vegetative powers of this plant, they are strong, and it is very hardy whilst young, living through the severest winter on exposed situations. It is of very slow growth, requiring nine or ten months to complete its maturity, and towards the last two, passes through the most delicate state of its existence; since within that space, the seasons and the soil have great influence upon its productiveness, being more than any other of the culminiferous plants, subject to their effects in the form of blight from lodging winds, and mildew occasion-

ed by an excess or loss of nourishment at that critical period.

The produce of wheat to the acre is from two quarters and a half to five, from seed of two bushels and a half to three and four. Manure applied to this crop, is, with few exceptions, injurious; because the growth of wheat is too much expedited by it, with no means of escape from the excess of the fertility by a proportionate increase in its vegetation and produce, and therefore falls a sacrifice to apoplexy, and yields at harvest dark coloured straw with a thin sample.

In those districts where wheat is much grown and its nature understood, it is always found most productive on soils of the clayey loam, that are fresh to this plant, not having grown the same for at least three or four years before, a manured fallow having intervened, and after a crop of beans or clover. It is usually sown broad cast, but if drilled, the rows are never more distant from each other than six to nine inches. Being a culminiferous plant, and with a straw not very stout, wide drilling would be unnecessary in the first place, and injurious in the second; because these slender stems, like the hairs of a brush, gain support and shelter from each other's near contiguity.

Stiff clays will often grow great crops of wheat, but it is when such soils have been fallowed, and

slightly manured. This preparation for the crop in question, is, however, only necessary on lands of the closest texture; because they require the fallow tillage to overpower their excess of tenacity, together with a moderate coat of manure, before they can be sufficiently ameliorated even for this plant.

On light lands, the very reverse of the stiff clayey soil practice is resorted to, as that of closing the soil, by the treading of sheep or horses, so to economise its fertility, that it may yield a steady supply of nourishment, according to the exigencies of the plant; and in a proportion sufficient to last throughout its growth. For on such land, wheat, if not so guarded, is disposed to grow luxuriantly through the winter and spring, and then, from the early extravagant exhaustion of its food, fail at harvest.

OF THE CULTIVATION OF WHEAT.

This plant, from the general slowness of its vegetation, needs little or no assistance from cultivation whilst on the ground*; since, by this practice,

* It is best to leave the surface of rich, absorbent, wet lands untouched; let the same get beaten down, and full of cracks, which is usually the case: the latter prove as drains; the close surface promotes evaporation; and together, by carrying off the excess of all rains, moderate the fertility of such soils, and thus preserve the wheat from apoplexy. At

more evil, oftentimes, than good arises, in consequence of the too frequent destruction of the coronal roots by its careless application, and over lightening the surface, thus occasioning the crop to be root fallen. The truth is, wheat should have a tilth made for it, and ready stored with fertility in such a passive state, as to yield to the wants of the plant only when demanded; otherwise, if quicker than this, the fear of the evil of apoplexy commences.

Having taken some notice of stiff, wet lands, and those of the opposite quality, a few remarks are necessary, touching the requisite depth of their tillage. They are these; that the cultivation by the plough is not necessary to be carried so many inches deep into land of a rich, wet, clayey nature, as those which possess, in their composition, a large share of chalk or sand: because, the effect of deep cultiva-

the same time, these cracks admit of the interchange of fresh air for stale, to and from the interior; which would, from the crust on the top, be in a greater or less degree prevented. Now cultivation would defeat these advantages.

The roll and harrows, or the harrows and roll, being passed once or twice over wheat in the spring, is generally sufficient cultivation for most soils. The former, on the light poor description, to promote absorption; the latter, on rich, wet lands, to favour, on the other hand, the escape of the excess of moisture; the harrowing being in many cases better omitted.

tion is an increase in the soil's capacity of fertility; together with its means of absorbing, retaining, and economising moisture, which are thus proportionally multiplied; and vice versâ: consequently, much of the labour of deep cultivation may be saved on all rich, wet soils; with more of it applied to sands and chalks. Attending to this, the excess of fertility of the one would be healthily checked, and the deficiency of it in the other, as healthily promoted.

Now, assuming the rich, wet clays, as the first description of soil;

The average as the second;

The sands and chalks as the third;

The scale of ploughing, as regards depth, is as follows:

From 3 inches to 6 for those of the first quality.
6..... 9..... average.
9..... 12..... last.

By not ploughing the first soil deep, the unmoved land beneath retains, undisturbed, its old water courses, made by decayed roots, worms, and cracks; and thus the excess of those showers, beyond the healthy demands of a growing crop, escapes. But by ploughing deep, as recommended for light soils, these very drains are destroyed, and therefore a proportional greater quantity of rain or moisture is retained for the nourishment of the crop.

By attending to the above, in the management of land, no small expense of labour may be saved to a double profit; besides applying the same less blindly than is usually the case, and to more effect where really necessary.

The dripping year 1824 confirmed, in many instances, the truth of these ideas relative to the depth of cultivating wet, clayey loams. For, in looking at the crops in East Kent, the wheat proved the best on light chalky soils, such as are usually denominated poor, but in good tilth. Turnips also proved better on lands in good condition, after a crop of peas or tares, than on a well cultivated fallow adjoining: because the pulse crop had consumed the early excess of moisture in the land; and what showers fell afterwards were no more than requisite for the turnips.

But with regard to what has been stated relative to deep and shallow ploughing, the seasons, &c. the agriculturist must take the average of the two first for the basis of his calculations, as the only means of approximating to any thing near a certainty; but over the seasons, &c. he has no controul, nor has he at present a plan of foretelling them. Having done his best so far, he must leave the rest to Providence, who rarely omits to reward wisdom and industry when and wherever they are displayed. It

is of material consequence to the productiveness of any crop, to commit it to the ground in due time; for by omitting so to do, the plant, of whatever description it may be, must hurry through its vegetation, which cannot be done but at the expense of the produce: since the secretions, in their requisite proportions, must be unhealthily effected when thus hurried on; but which is not the case if the plant be allowed a sufficient time for its proper unfolding and maturing.

Experience has proved this most satisfactorily: for the straw of the late sown crop, is less firm, the sample thinner, lighter, and less abundant, than the one early sown. This fact should be borne continually in mind by every young agriculturist; because there is no difference in the expense, but the gain is certain, and only requires a little forethought in the arrangement of the economy of the farm.

Relative to the period of sowing wheat; this must depend on the nature of the soil and situation. Lands of a wet, backward, stiff description, cannot be got in too near the month of August; because it is necessary to have the wheat up, and the plant established before the wet season sets in; when the sowing would be nearly, if not quite, impracticable. Even if completed only a few days before this season, the wheat will be unable to so far vegetate, as

to throw up a strong blade, and get sufficiently rooted in the ground before winter sets in; and the rotting of many clevels likely to ensue.

On wet lands, under the above circumstances, there is no fear of the wheat plant injuring itself by running away, and becoming winter proud; for immediately on the soil being saturated with rain, the balance of affinities follows, which guards against all excess, at that period of the year, and continues till released and set into activity by the dry weather of the succeeding spring.

Land of a medium degree of closeness, as loams on a dry subsoil, need not be sown till October or November. Those of the sandy, chalky, and gravelly, kinds, may be postponed to the first week of December; when, generally speaking, a sufficiency of rain will have fallen to occasion such light soils to cut up close with the plough.

A few questions arise, which are, whether stale ploughed land is better to sow upon than fresh*, or

* Experienced agriculturists usually commence their ploughings for wheat with their clover lays. Their motive is, that the land may have sufficient time to get wet and close enough before sown; which it does the speedier, by the soil arresting a far greater proportion of the autumnal rains, than if the same land had continued undisturbed, when the showers would have soaked nearly all away. This fact is strongly apparent on walking by the side of a plough the

the reverse, or both at times; and when? They may be answered thus: that as the wheat crop usually occupies from one to two months, from the commencement of the first ploughing to the conclusion of the last harrowing; and as the object of the agriculturist is to have his wheat nearly on an equality as to the forwardness of its vegetation; so the earliest sown wheat requires to be checked, at least on land of the same quality; and hastened on that last sown. Both of which is accomplished by sowing the first wheat on the stale furrow; the middle and last on the fresh: the owner also employing his judgment to select and arrange each field for the ploughing and sowing, according to their nature and peculiarities. With average soils it is safest to have all the stale ploughed land put in and finished

morning after a wet night, when the then turning furrow will appear quite dry, in comparison with those of the day preceding. The water thus detained, promotes the closing of the land; first, by its weight, next, being in sufficient quantity to cause the soil to work together under the treading of the horses during the operation of the harrowings: like the assistance a pond maker derives from water, in a certain quantity, whilst ramming his clay when rather too dry. Again, by such land being broken up in good time, it may be the earlier sown; when the plants will become well established before Christmas, and thus better able to resist any attacks of the worm.

the first week in November, and then sow after the plough till the season is completed, for as the power of the sun declines, the fresher should the land be sown.

OF THE OAT.

The oat is a culminiferous plant of the grass species, and shoots up one or more stems to the height of three, four, and five feet. Its straw is stouter than that of wheat, but not so stiff and durable, and it throws out at its joints a larger leaf or riband. Six months is sufficient time for the oat to arrive at maturity, and four bushels sown as seed upon an acre, will yield from four to ten quarters.

The productiveness of the oat is one of its peculiar features, being greatly more prolific than any other species of corn. It is a hardy plant, and in consequence of its superior produce will pay better on most poor soils than wheat. Its decomposing or vegetative powers also exceed those of wheat, and is therefore a fitter plant to be sown on recently manured land, besides, having the property of more rapid vegetation, possessing a broader riband, with a greater disposition to stock out, and less liable to blight than the plant above alluded to.

The conclusions to be drawn from the nature of the oat, are, that it requires a lighter soil than

wheat, or at least to be made so by cultivation, and from its powers of vegetation may be sown near to a manured fallow. Being of the grass species, it should be sown broad-cast, or in close drills, for the same reasons as for wheat.

The favourite soil for the oat is a loam, and the season, a turnip fallow fed off, then ploughed and sown the end of February, or early in March, when the produce will often equal at harvest, on rich soils, ten quarters to the acre.

A few remarks relative to the time of ploughing turnip land are considered necessary.

Turnip land, it may be taken for granted, is rich in fertility from the preceding year's fallow, and the crop being fed off: therefore, the object in preparing the same for oats, is not now so much to enrich the soil, as to provide a fit season for that crop or barley. To do this, the subject must be divided into two parts, the wet stiff land, and that which is light and dry. The former should remain unploughed throughout the winter, because the flatness of the surface, from being fed off with sheep and the old water-ways, will essentially assist in the riddance of any excess of rain or snow, by the evaporation from winds, as the water will remain longer on a smooth close trodden surface, than on one that is tender and rough. But it must be understood, that to leave land of the above

description unploughed till it becomes dry and hard, would be to run to the other extreme: therefore, to avoid both, the land should be immediately ploughed after January, as soon as it will do so without injuriously kneading.

Light, dry land may be ploughed as soon as practicable after Christmas, when it will rather cut up, because the subsequent frosts will sufficiently pulverize it for oats, with the advantage of gaining more by being ploughed up and exposed to the sun, air, &c., than if left undisturbed, except for the reasons before adduced. However, fed off turnip ground should be broken up as early as the soil will admit: first, for the above motive, next, with the view of getting forward with the general ploughing of the farm, that the command of a few fine seasoning days, in this precarious climate, may not be lost when they offer, on account of the field being unprepared for the seedsman.

OF BARLEY.

This plant is also culminiferous, and of the grass species, and shoots up a stem or stems thirty inches to three feet in height. It is particularly rapid in its growth, and produces, from three bushels of seed on an acre, three and a half quarters to seven. Its nature is more delicate than the oat, and

with less vegetative powers, yet will bear putting much nearer to manure than wheat, and is seldom liable to blight.

The soil and season best calculated for barley, has been proved to be a sandy or chalky loam, after a turnip fallow fed off, and sown not later than the end of March or the first week in April. It should be sown the same as wheat or oats.

OF CLOVER.

This is a biennial plant, and a most valuable vegetable as green or hay food for horses and stock. It is generally known as one of the artificial grasses. It possesses a strong tap root with a succulent stem and trefoil leaf, and grows to a foot and eighteen inches high. It is sown among wheat, oats, and barley.

Clover requires a rich, fresh, deep soil, and good season, and ought never to be attempted on the same field oftener than once in six or eight years*, otherwise the land loses its freshness for this plant, and is proportionally less productive; besides encouraging, in a destructive degree, both the worm and couch grass. The crop is never made use of, except for sheep in the autumn, till the second year, when it may be fed off or mowed, or both.

* The latter period is to be preferred on almost all soils.

Being a grass, it is of course sown broad-cast, and at the rate of six quarts to two gallons on an acre, or from twelve to sixteen pounds; and the operation performed the end of March or beginning of April.

The manure most advantageous to clover is soot and coal ashes spread over the land the second year, in February or March, at the rate of thirty to fifty bushels to the acre.

OF TREFOIL.

Trefoil is very similar to clover; it is in fact a dwarf species of that plant, and requires the same soil and culture.

SAINFOIN.

This artificial grass is of longer duration than clover, and exceeds it in all its dimensions. It is of a hardier nature and possesses superior vegetative powers than clover, and consequently will grow and be productive on much poorer soils. In fact, this plant is the only one calculated for the cold chalky hills of England, on which it will continue productive four or six years.

The soil most congenial to sainfoin, is a chalky loam, as lime must compose a part of the earth on

which it is grown. The season is, with oats or barley, after a turnip or other fallow; or with wheat, after a naked fallow on stiff land. The produce is devoted to the feeding of stock either in the green or hay state, or it is sometimes on moderate fertile lands saved for seed.

It should be sown the first favourable time in March, and the quantity of seed for an acre, broadcast, is three to four bushels.

CHAPTER IX.

On the courses of crops.—A list of the courses of crops. —These several courses combine the four first principles of husbandry.—Observations on the sowing of seeds and seed corn in general.—The injurious kneading of wheat land in the autumn removed by the winter's frosts.—A few facts respecting vegetation.

COURSES OF CROPS.

After this outline of the nature of those plants most generally cultivated, it remains but to arrange them into courses as at first proposed.

To begin which, the manured fallow must certainly take the lead, and if the field be considerably run out, a whole year's tillage will be requisite, otherwise turnips may be grown to be fed or carted off at the discretion of the owner; the former is decidedly preferable, unless the soil is naturally too wet for the attempt.

The course of crops proposed for the best land is,

1. A fallow manured.
2. Oats.
3. Clover.

4. Wheat.
5. Beans, potatoes, or mangel wurzel, manured.
6. Wheat.
7. Peas, tares, or beans.
8. Wheat.

To fallow again, which is quite necessary, to keep even the best land in a healthy corn-producing state, since straw may always be raised by the aid of manure alone. After the fallow this time, may follow barley instead of oats, if the soil be the least genial for that crop, as this change will be advantageous in the series even if the produce prove not large, since what may be lost in one crop will be obtained in one or other of those that come after. Or it may be taken thus,

2. Let the crop be oats as before.
3. Clover.
4. Wheat.
5. Peas, tares, potatoes, &c., manured.
6. Barley.
7. Beans.
8. Wheat.

Or on land that is disposed to throw out an excess of straw, particularly that of wheat, the course may be,

1. Fallow manured.
2. Oats.
3. Wheat.

These two white straw crops being close together, will insure the latter against the evils of extravagant fertility; but this system can only be practised with safety and profit on the very best lands.

4. and 5. Clover for two years, and sooted.
6. Wheat.
7. Beans manured.
8. Wheat.

Or, in the fourth, Peas or tares, manured or fed.

5. Barley.
6 and 7. Clover or grass for two years.
8. Wheat.

To fallow again.

On average lands the course may be,

1. Fallow manured.
2. Oats.
3. Beans slightly manured.
4. Wheat.
5. Clover, sooted or fed off.
6. Wheat.

Or,

1. Fallow manured.
2. Oats or barley, but clover is less injurious to the oat crop in a wet harvest than to barley.
3. Clover sooted.
4. Wheat.
5. Turnips manured and fed off.
6. Barley.

7. Beans, or potatoes manured.

8. Wheat.

For the poorer soils,

1. Fallow manured, and cultivated for two years, if very foul and exhausted.

2. Wheat or oats.

3. Clover, sooted or fed off; peas, tares, or beans, slightly manured.

4. Oats or wheat.

Again,

1. Fallow manured.

2. Barley or oats.

3. Clover, peas, tares, sooted, manured or fed off.

4. Oats or barley.

Or,

1. Fallow laid down to grass, as sainfoin, for a few years. Pared and burnt, fallowed and manured for turnips or cole.

2. Barley or oats.

3. Peas, tares, or beans, or the tares fed off

4. Oats or wheat.

These several courses combine the four first principles of the art of husbandry, the fallow, manure, variation of crops, and the laying down to grass for one or more years.

Something of the above arrangement it is the policy for every husbandman to adopt; first, for the sea-

sons before shown, next, for the sake of inducing order about a farm. The courses can be formed differently, at the option of the farmer, but the principles must not be departed from where a permanent return is looked for.

Before coming to the conclusion, let me take some notice of the sowing of seeds, &c., and state a few instances of vegetation.

OF SOWING THE SEEDS AND SEED CORN IN GENERAL.

The principles here to be attended to, are, that the corn, of whatever description, should have the soil made sufficiently close, yet tender about it, to prevent any circulation of fresh air beyond what the effects of vegetation may occasion. For if so close as to establish a complete exclusion of all fresh air which ensues on kneading land, the balance or stand-still is the consequence. On the other hand, should the soil lie loose about the clevels of corn, the proportion of air proves too great for decomposition, dryness is favoured, and from this other extreme, vegetation continues dormant till some genial closing showers follow, when, by chance, vegetation may go on healthily, but it is too apt to cease afterwards in part or altogether, and is one cause of the thinning of crops.

The soil, in fact, must be close enough to retain

its air and moisture in immediate contact with the clevel, or they cannot be healthily decomposed for the benefit of the seed, which process must necessarily take some time: but when any part is accomplished, the disengaged and rejected proportions should be able to escape, to make way for more fresh, which interchange is, as before stated, materially promoted by every subsequent shower.

We see, on looking over fallow land not dressed down after ploughing, how few seedling weeds there are springing up, and principally for the cause above given, together with the absence of the shelter, which no doubt growing corn affords to weeds. But when this fallow land is closed by repeated scarifyings, harrowings, and rollings, even if no rain follow, germination commences; thus pointing out most clearly the propriety of adequate attention being paid to the spring tillage before and after the corn is committed to the ground, with the prudence of deferring for a few days the sowing and finishing of that field which should plough up too wet to bear the process immediately.

The kneading that so frequently occurs in wheat season, is removed by the winter's frosts; and the hollownesses, by the rains and snows*. It should be borne in mind, that the smaller the seed, and

* This is the reason why trees planted in the autumn more usually succeed than those deferred till the spring.

the later and drier the time when sown, the finer ought the tilth to be; the turnip is an instance.

If we examine a few facts of vegetation we shall find them as under. Corn, in a wet harvest, is first detected growing about the bond; next, among the ears where collapsed together. The evil is remedied by simply loosening the one, and separating, or spreading open with the hands, the other, to admit of a circulation of air, which arrests all further vegetation, till more rain falls to closely reunite them again. The same follows of mown barley, when the ears are permitted to remain in contact with the ground during a series of warm showers; but lightly lifting them up and letting them fall again, or turning them over, effectually preserves the crop, if done, and repeated, in time.

Cases analogous to the above.—Boards or timber fresh sawn out, and put close together, will soon generate the dry rot if some slips of wood are not placed between each board or piece of timber of sufficient thickness to admit of a free circulation of air.

Damp paper, and damp linen, will exhibit marks of the same evil as the boards, and if long neglected will be completely destroyed.

The air, being retained, is decomposed, when the destructive or vegetating process commences, and with a fire it burns.

CHAPTER X.

Conclusion.—Hints to young agriculturists.—Agriculture should be carried on with a view to profit; and which is only obtained by continued attention. The advantage of getting well forward in the business of a farm; and the servants, being consulted, will assist to this end.—Servants should be treated kindly.—On laying out of capital.—Mr. Marshall's saying.—Man will always be able to supply himself with food.

CONCLUSION.

The young agriculturist having perused and weighed the contents of these pages, must next direct his thoughts to the practical part, which should be always carried on with a view to profit, otherwise he neither benefits himself, nor, in the end, society.

This profit in agriculture, from the immense competition and the variety of the seasons, is only to be obtained by a continued attention, on the part of the conductor, to the economy of money and time, that is to say, every footstep of his men and horses should leave behind it the impression of utility and profit. And nothing so favourably con-

tributes towards both these, as a good system of arrangement throughout the farm, of a simple description, that even his men may see and understand what he intends to do for at least some months beforehand, as respects the grand features. Having accomplished this, it will be in his power to get well in advance in all his business, an object of the first consequence in the climate of Great Britain, and which alone can enable him to take advantage of every precious opportunity that may offer.

By the executive men being acquainted with the intentions of their master before they are put in practice, they will (if possessing intelligence with their experience) canvas over, in their own minds, the practicability and chance of success of the plans proposed, and if they feel the least interest in their master's welfare, and are allowed by him to give their opinion now and then, may foresee an evil, or point out a shorter and better road; or, by raising a doubt, sometimes induce him to think twice before he acts; a circumstance of more moment than is usually supposed.

If a master possesses a liberal disposition, accompanied with a real thirst for knowledge in his profession, he will with pleasure listen to any suggestions on the part of his men, who should be few and good: and to have such, pay them well. He may thus oftentimes hear truth; though conveyed

not in elegant language; still it is truth. Indeed, by treating labourers as rational beings, instead of mere machines, which is now and then the case, and arguing with them a little, both parties are benefited. They then feel an interest in the varied occupations on the farm, and derive a proportional degree of pleasure in the employments, and in the success, all of which proves a balm to their toils, and an increase, not only to the purse, but to the happiness of their liberal and enlightened director.

With respect to the laying out of capital on a farm, very great circumspection ought to be used by the young agriculturist, with a few years' experience of the soil, before it be largely ventured upon. What is meant by laying out of capital, is, in the purchase of distant manures*, draining,

* As manure stands next in importance to cultivation, every attention ought to be paid to the economy of all straw and litter, likewise, to the guarding against every kind of waste by heating, winds, &c., and that the crumbs of manure, as Cobbett justly says, should be also carefully swept up; for what is obtained even in this way, is at home, is free from carriage expense, and will, in most instances, equal in goodness what is purchased at a distance, saying nothing of the charges upon the same. And it is too often the case, that the time consumed with a team to fetch a load of manure, would plough well an acre of land at home.

The way to raise the greatest quantity of manure from

building, &c., and the employment of an extra number of hands and horses.

Let a recourse be had to those means first which are attainable on the farm; these, conjoined with the practice of fallowing, and a judicious system of crops, will effect wonders with most lands. When the above have been tried, and certain positive improvements may be made, with a fair remuneration, no excuse will then remain for delaying longer the outlay of the requisite money.

This work may be advantageously closed by joining with Mr. Marshall, in saying, that "self-atten-

straw and litter, is, in the first place, to eat none or next to none of the straw; but instead, to trample all as it comes from the flail, under the feet of stock fed on hay, corn, cake, or roots. In the next, take every wet day opportunity to carry out to a mix-hill all which is in a state of incipient decay, and never mind some long straw going with it. Lastly, when the mix-hill is finished, let it be turned, and after a few days be carted out and ploughed into the soil, so that the manure may undergo the greatest proportion of its fermentation within the land rather than in the mix-hill. By this plan, all the straw grown on the farm at the last harvest, will be usefully employed in the soil on or before the next harvest, except what must be stored by for litter and thatching.

The above is quite practicable when the manure is to be devoted to the fallow or fallow crops, and will yield at the rate of thirty cubic yards to forty upon an acre, over a quarter of the farm.

tion makes the best farmer"; for without this even science fails, but with it every thing improves, and, conjoined with science, every thing succeeds.

The result of these enquiries will, it is hoped, confirm our minds in the opinion that the sources of fertility, under the fostering hand of civilized man, are as immortal as his own species; consequently, as long as he inhabits this globe, he will always be able to supply himself with food, by devoting a certain proportion of his industry and skill to the cultivation of its soil, and to the care and propagation of its various products.

THE END.

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